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UNITED STATES FUEL ADMINISTRATION —

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H. A. GARFIELD, Fuel Administrator

OIL DIVISION

M. L. REQUA, General Director

PRICES OF PETROLEUM AND ITS PRODUCTS DURING THE WAR

By

JOSEPH E. POGUE

Of the Oil Division, United States Fuel Administration

Assisted by

ISADOR LUBIN

Of the War Industries Board



An investigation made in cooperation with the Price Section
Bureau of Planning and Statistics
War Industries Board



WASHINGTON
GOVERNMENT PRINTING OFFICE

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UNITED STATES GOVERNMENT

DEPARTMENT OF THE INTERIOR

Geological Survey

Washington, D. C.

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JOHN E. LOGG

Geologist, U. S. Geological Survey

Washington, D. C.

1919

U. S. GOVERNMENT PRINTING OFFICE



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TABLE OF CONTENTS.

	Page.
Foreword.....	7
Introduction.....	9
The significance of price.....	9
Price factors peculiar to petroleum.....	10
The basic character of petroleum.....	10
Occurrence of crude petroleum.....	10
The composition of crude petroleum.....	12
The production of crude petroleum.....	12
The transportation of crude petroleum.....	14
Imports of crude petroleum.....	16
The refining of crude petroleum.....	16
The distribution of petroleum products.....	18
The demand for gasoline.....	20
The demand for kerosene.....	21
The demand for fuel oil.....	21
The demand for lubricants.....	22
The demand for by-products.....	23
Miscellaneous special price factors.....	23
Commercial history of the petroleum industry.....	24
The era of kerosene dominance.....	24
The development of the gasoline motor.....	24
The Cushing depression.....	24
The war and the period of fuel oil dominance.....	25
The emergency control.....	26
The armistice and the advancement of the motorized age.....	29
The price record.....	30
General explanation.....	30
The prices of crude petroleum.....	31
The prices of gasoline.....	34
The prices of kerosene.....	36
The prices of fuel oil.....	38
The prices of lubricating oils.....	39
The prices of by-products.....	41
Summary.....	49
Summarized comparison of the actual prices of petroleum and its main products.....	49
Summarized comparison of the relative prices of petroleum, petroleum products, and commodities in general.....	49
The price and value relationships of the petroleum industry.....	53
Needs of the price situation.....	54
Acknowledgments.....	55

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LIST OF ILLUSTRATIONS.

	Page.
FIG. 1. The crude petroleum situation in the United States, 1913-1918, showing the relation between marketed production, imports, stocks, refinery consumption, and total consumption. Data from U. S. Geological Survey, U. S. Bureau of Mines, and U. S. Fuel Administration.....	14
2. The growing gap between production and consumption of crude petroleum in the United States. After David White, U. S. Geological Survey.....	15
3. The bulk and value of the domestic production of petroleum products in 1918. Data from Bureau of Engineering, Oil Division, U. S. Fuel Administration. Refinery consumption includes crude plus materials re-run; values are estimated realizations and differ somewhat from the market values given in figure 23.....	17
4. Estimated average return per barrel of crude petroleum refined in 1918. Data from Bureau of Engineering, Oil Division, U. S. Fuel Administration.....	18
5. Diagram showing quantitatively the interplay between the main petroleum products, and giving in comparative form the relations between the production, consumption, stocks, and exports of gasoline, kerosene, fuel oil, and lubricants. Data from U. S. Bureau of Mines and U. S. Fuel Administration.....	18
6. Graphical view of the demand for gasoline in the United States. Data from U. S. Geological Survey, U. S. Bureau of Mines, U. S. Fuel Administration, War Industries Board, and National Automobile Chamber of Commerce. Note relation between one-fifth of crude petroleum output (the natural gasoline content) and the actual production of gasoline.....	20
7. The increase in values resulting from manufacture (fabrication factor) in the petroleum industry, 1913-1918.....	23
8. The estimated unmined supply of crude petroleum in the United States. Data from U. S. Geological Survey. Note in connection with figure 9.....	26
9. The estimated future production of crude petroleum in the United States on the basis of the recent rate of increase. The growth in output indicated can scarcely be expected in view of the size of the reserve (see fig. 8), which means that increasing imports and increasing efficiency in utilization must come into play.....	27
10. Actual market prices of crude petroleum in five fields.....	33
11. Relative price of crude petroleum. (Weighted average of five leading fields.).....	33
12. Actual market prices of gasoline.....	35
13. Relative price of gasoline. (Average of five leading American markets.).....	35
14. Actual domestic and export prices of kerosene.....	37
15. Relative prices of kerosene. (Average of five leading American markets and export price at New York.).....	37

	Page.
Fig. 16. Actual realized and market prices of fuel oil.....	39
17. Relative price of fuel oil. (Average of five markets.).....	39
18. Actual market prices of lubricating oils at New York City.....	41
19. Relative price of lubricating oils. (Average of five grades at New York City.).....	41
20. Relative prices of petroleum by-products—petrolatum and paraffin...	42
21. Average actual prices of (1) crude petroleum, (2) gasoline, (3) kerosene, (4) fuel oil, and (5) lubricating oil.....	49
22. Relative prices (weighted averages or "index numbers"), of (1) crude petroleum, (2) petroleum products, (3) "all commodities," and (4) the petroleum industry (crude plus products).....	50
23. The price and value relationships of the petroleum industry, 1913-1918. Use for gaining a view of relative changes; not fully reliable for specific use, owing to imperfections of data.....	52
24. The price and value relationships of the petroleum industry, 1913-1918, reduced to a percentage basis. Data taken from figure 23 opposite. Use for gaining a view of relative changes; not fully reliable for specific use.....	53

LIST OF TABLES.

	Page.
TABLE 1. Wholesale prices of crude petroleum and gasoline.....	43
2. Wholesale prices of kerosene and lubricating oils.....	45
3. Wholesale prices of fuel oil, paraffin, and petrolatum.....	47

FOREWORD.

That prices of petroleum products were controlled during the war is evidenced by an examination of the prices of two uncontrolled products, petrolatum and paraffin wax, as compared to the prices of gasoline, kerosene, and fuel oil.

This control was exercised first by the Council of National Defense in cooperation with a committee from the oil industry. After the organization of the Oil Division of the United States Fuel Administration, this committee was greatly enlarged and became the National Petroleum War Service Committee.

Due to concerted and individual action by members of this committee acting under the supervision of the Oil Division of the Fuel Administration, prices were undoubtedly markedly controlled and advances checked during the winter and spring of 1918. One advance of 25 cents per barrel on Mid-Continent crude was agreed to, with adjustments in other fields, including California. An advance in the price of gasoline (of one-half cent) to compensate for the advance in railway freights was also sanctioned.

The stabilized prices of finished products were threatened in the spring months by the premium offers made for crude, and the whole situation was so seriously menaced that some definite and positive plan became necessary. This was the condition that caused the adoption of "The plan to stabilize and maintain uninterrupted flow of crude," which became known as "The Plan."

Taken in connection with the agreed prices for the Allies, these two voluntary acts had a profound effect upon prices; supplementing, as they did, the voluntary and tacit understanding between the Government and the industry that prices should be controlled by voluntary action rather than by Government order.

The authority of the Fuel Administration to fix coal prices, as provided in section 25 of the Lever bill, did not extend to petroleum; and while it was probably possible to control prices through control of profits, as provided for in the Lever bill, it was an indirect and cumbersome method of accomplishing the desired result as compared with voluntary agreements with the Government by the industry, definitely controlling within certain limits the prices of the various products.

Reference to the curve of all commodities, on page 50, will show that petroleum products in 1918 were no more expensive relatively than they were during the period of depressed prices in 1915, and less expensive relatively than at any other time in 1913 to 1918, with

the exception of a few months in 1916, when the crude market was recovering from the Cushing depression.

To this extent and particularly in view of the paramount importance of petroleum as a war necessity, the control exercised by the Fuel Administration through the Oil Division and by the industry through the National Petroleum War Service Committee may be considered as successful. This is particularly true in view of the decline in production; the normal increase in consumption, and the draft on stocks that was contemporaneous with our war activities but not due thereto. This condition was only rendered more acute by war demands; it existed irrespective of the war, and would have caused increased prices for crude, with resultant effect upon refined products, even without the influence of war demands.

April 1, 1919.

J. E. POGUE.

PRICES OF PETROLEUM AND ITS PRODUCTS DURING THE WAR.¹

By JOSEPH E. POGUE,
Of the Oil Division, United States Fuel Administration,
Assisted by ISADOR LUBIN,
Of the War Industries Board.

INTRODUCTION.

The significance of price.—Price is the outcome of the interplay between supply and demand, the result of the give and take between production and consumption. An analysis of a run of prices, therefore, must appraise the factors, few or many, that lie beneath the surface of price fluctuations. These factors become more numerous and the situation in consequence more complex in proportion as the principles of chemistry, physics, and mechanics enter into production, with added complexities, in turn, as consumption is dependent upon a further body of technology. If, in addition, the raw material has peculiarities of occurrence and character such as lead to unusual methods of handling and treatment, while the output of fabricated commodities is a diverging series of joint products employed in a wide and fundamental range of independent industries, the fabric becomes intricate to an extreme degree. Such is the case with petroleum and its products, and an interpretation of price data in this field involves, indeed, an explanation of the industry itself.

A period of unusual stress, by accentuating the effect of certain factors at the same time that others are left constant, offers a favorable opportunity for the determination and weighing of economic forces that underlie prices and therefore influence the functioning of industry.² Hence a price study of petroleum and its products during the war may serve not merely to provide a historical record of bygone phenomena, but may be made to yield a view of the industrial struc-

¹ This bulletin is prepared in coordination with a series of price histories compiled by the Price Section of the Bureau of Planning and Statistics of the War Industries Board, which deal with the fluctuations in the prices of 50 classes of commodities during the past six years. The series includes group studies of prices of foods, clothing, metals, building materials, fuels, and chemicals; international comparisons of price fluctuations; a special record of governmental control over prices during the war; and a general summary of the whole inquiry in which the methods employed are set forth more fully and the leading results from all the individual bulletins are drawn together for comparison. The various parts of this series are published separately by the War Industries Board, of which this bulletin is part 36.

² For the sake of simplicity, the inquiry starts from the assumption that prices are the response to the free operation of natural laws in the realm of production and consumption, without assumption of artificial influences other than those proved by the price curves themselves.

ture such as may be of constructive value in the future both within the industry and outside.¹

Since an explanation of price fluctuations depends upon an appreciation of the factors peculiar to the case, as well as those common to all commodities that are bought and sold, it is necessary at the outset to visualize the significant aspects of the petroleum industry in as clear perspective as the call for brevity will permit.²

PRICE FACTORS PECULIAR TO PETROLEUM.³

The basic character of petroleum.—Petroleum has a vital bearing upon modern affairs because it is the source of gasoline, upon which automotive transportation is dependent; provides kerosene, the most important illuminant outside of cities; yields fuel oil, from which the industrial activity of much of the country draws its energy; and supplies lubricating oils upon which the wheels of industry revolve.⁴ Petroleum is an energy resource which shares with coal and water power the responsibility of activating the industrialism and transportation of modern civilization.⁵

Occurrence of crude petroleum.—Crude petroleum is a mineral occurring in liquid form inclosed within the crust of the earth under pressure, so that once reached by a drill hole it affords an ease of pro-

¹ Throughout this report the attempt has been to present all data on a quantitative basis in relative form for comparison; accordingly, numerous charts have been introduced and no attempt has been made to paraphrase these data in words, other than to call attention to the main points of significance. Some of the charts are complicated, but necessarily so, since the relationships they represent are not simple; it is felt that the more involved charts, in particular, will repay careful study. All units of measure quoted in this bulletin are in dollars, cents, barrels of 42 gallons, gallons (U. S. standard), and degrees Baumé. It is scarcely necessary to mention that the bulk and density units are highly inconvenient and justifiable only on the basis of habit.

While the writer is a member of the Oil Division of the Fuel Administration, the present report represents a scientific study of prices, freed so far as possible from the personal and official equation; the conclusions are published by the Fuel Administration as a scientific contribution to the subject, without necessarily in all instances representing the official views of the administration.

² A nontechnical view of the oil industry, with special reference to the economic aspects of oil technology, may be found in *Petroleum: A Resource Interpretation*, by C. G. Gilbert and J. E. Pogue, Bull. 102, pt. 6, U. S. National Museum, 1918. A more technical treatise is, *The American Petroleum Industry* by R. F. Bacon and W. A. Hamor, 2 vols., New York, 1916. An effective account of the oil industry in California is contained in the Report of the Committee on Petroleum, California State Council of Defense, Sacramento, 1917.

The price factors common to commodities in general are not treated, being regarded as sufficiently familiar without specific reference.

⁴ Petroleum is also requisite to the operation of an oil-burning navy, is coming into prominence as a motive force for ocean shipping in general, and forms the basis of an undeveloped by-product industry of unlimited possibilities.

⁵ Petroleum is a priceless resource for it can never be replaced. * * * It has taken ages for nature to distill it in her subterranean laboratory. * * * To industry, agriculture, commerce, and the pleasures of life petroleum is now essential. (Franklin K. Lane, Reports of the Department of the Interior for 1915, vol. 1, p. 16.)

The operation of hydroelectric generators, of railways and trolley cars, of the machinery of the factories, of internal combustion engines, of our battleships and our merchant ships, in fact, of all machinery, is made possible by the use of one product, and of one product alone—petroleum. (M. L. Requa, *Petroleum Resources of the United States*, Senate Doc. No. 363, 1916, p. 5.)

duction paralleled by no other substance.¹ Under conditions of small holdings and competitive mining as prevalent in the oil fields of the United States, this ease of production leads frequently to sudden and spectacular flows of oil in gross excess of facilities for caring for the output. At times an overproduction develops of sufficient magnitude to depress the markets of the entire country. (See fig. 21.) As the cumulative result of a succession of such periods, the production of petroleum in the United States has grown in advance of the development of a balanced set of demands, with the consequence that a surplus production over the needs of refineries has always been in evidence, while in respect to refined products there are constant difficulties in the form of an immature market for those products turned out jointly with the product in greatest demand.² These circumstances have conspired to hold the price of crude petroleum at relatively low levels, in comparison with the intrinsic worth of the product and the prices of other materials rendering analogous service.

Petroleum occurs in many parts of the country, with the fields of Oklahoma-Kansas and California producing about two-thirds of the country's output.³ The location and productivity of the various oil fields are important factors affecting the prices of refinery products, with a significance to be gathered from the following table showing the 1918 production:

Field.	Production in 1918.	Field.	Production in 1918.
	<i>Barrels.</i>		<i>Barrels.</i>
Appalachian.....	25,300,000	Gulf Coast.....	21,700,000
Lima-Indiana.....	3,100,000	Rocky Mountain.....	12,600,000
Illinois.....	13,300,000	California.....	101,300,000
Oklahoma-Kansas (Mid-Continent).....	139,600,000	Total.....	345,500,000
Central and North Texas.....	15,600,000		
North Louisiana.....	13,000,000		

Because of the rapid exhaustion of oil pools under active exploitation, a sustained flow of raw material necessitates a continuous campaign of exploration in advance of active production. This search for new sources of oil, while a necessary part of production, is carried on to a considerable extent by individuals and agencies ("wildcatters") that drill untested territory under the stimulus of large returns in event of success. As a result, part of the the expense of unsuccessful exploration is borne by interests that never attain production, and by so much is the cost of actual output minimized in its bearing upon the price of crude. Crude prices, on the other hand, by common

¹ Exception should perhaps be made of natural gas and artesian water, with each of which, however, petroleum is often associated.

² This economic phase of petroleum refining can not be too strongly emphasized. (See also pp. 17-18.)

³ A detailed map showing the oil fields and pipe lines of the United States was published in 1916 by the U. S. Geological Survey. (See also figs. 2 and 7, Bull. 102, pt. 6, U. S. National Museum, 1918.)

consent are deemed inadequate if they do not afford a margin of profit sufficient to hold out a prize ample to stimulate wildcatting.¹

The composition of crude petroleum.—Petroleum is (probably) a natural distillation product resulting from accumulations of organic matter buried in the sediments of ancient swamps and seas. It contains an almost endless variety of hydrocarbon compounds, together with small proportions of nitrogen, sulphur, and oxygen. It is high in heating value, representing therefore a concentrated source for the production of energy; carries various materials useful as lubricants in conserving energy; and, comprising both chain and ring compounds (the basis of synthetic organic chemistry), provides raw materials for the chemical manufacture of a diverging series of commodities.

From a physical standpoint, petroleum is a mixture of liquids of various densities, holding in solution natural gas (usually) and solid substances such as paraffin wax or asphalt (or both). When subjected to evaporation or the more rapid process of distillation, these substances pass off in the order of their volatility until a solid residue is left. The crude petroleum falls roughly into three classes according as the solid content is chiefly paraffin, asphalt, or a mixture of the two, with the gasoline and lubricant constituents greatest in the case of the paraffin oils and smallest in the asphaltic crudes. Since the paraffin oils occur in the more populous parts of the country and were the first to be exploited, they have stimulated a higher and better balanced range of demands than have the asphaltic oils, which, coming into play more recently in the Gulf and California regions, have found their main outlet in the form of fuel for steam-raising purposes. In consequence, the paraffin oils, containing the products in greatest demand, command the highest prices, while the asphalt crudes bring the lowest returns, with oils of mixed base intermediate in market value. Special features of composition, especially sulphur content, have a bearing upon price when introducing difficulties in refining.

The production of crude petroleum.—Petroleum occurs at various depths beneath the surface, so that wells hundreds to thousands of feet in depth must be drilled to tap commercial deposits. As the drill holes, in many instances, must be cased with pipe, while the outfit of steel tools employed in drilling operations is expensive, the cost of iron and steel is the most significant item in the cost of oil

¹It would be an interesting though difficult problem to determine the proportion of exploration cost that is debited against "cost of production" under the present system of oil-field development. While the matter is open to question, it is felt that wildcatting is, from an economic viewpoint, a costly substitute for engineering exploration, and in the aggregate works a greater net gain for the active producers than for the wildcaters in total. If this is true, wildcatting has a significant price relation. In any event, oil exploration (in the United States) is markedly at variance to the prospecting employed in developing other resources, and its peculiarity should be held in mind.

well drilling. The weight of this factor may be judged from the fact that normally about one-twelfth of the country's output of iron and steel is consumed by the oil industry. The cost of labor, on the other hand, does not appear so prominently in the balance sheet, especially as compared with the production of other raw materials, owing to the largely automatic character of oil-well yield, once oil is struck in paying quantities. The number of wells, or rather the aggregate of drilling, necessary to produce a given quantity of oil varies widely in different parts of the country, and in any given field increases in proportion as the oil approaches exhaustion. These circumstances are reflected in the widely varying output of individual wells, which ranges from a maximum of 50,000 barrels or more per day down to yields of one-half barrel, or even less.

On the whole, then, except in old fields nearing exhaustion and in so far as the high-cost areas set the price pace for the entire country, the cost of production does not dominantly influence the price of crude petroleum, which has to carry in addition the intangible but very appreciable item of incentive for exploration. With continued progress toward depletion of the resource, however, the increasing proportion of drilling necessary to sustain production may be expected to make the cost of production increase and weigh more and more in the price outcome.¹

When a new oil field is opened up, there almost inevitably results a period of overproduction, with a depressing effect upon the crude oil market of local to country-wide effect, depending upon the volume of output. In such instances, however, the presence or rapid construction of storage facilities ultimately absorbs the surplus output at a low price,² thus reestablishing the normal run of price conditions. In consequence of a succession of such events, of which the Cushing Pool provides the most notorious example, the supplies of crude oil in storage have grown to large size. For many years these stocks have approximated a six months' or greater supply of crude, exceeding the quantity essential to keeping the physical flow of raw material mobile and providing an ample, and perhaps at times a somewhat excessive, margin of safety besides. The condition of petroleum stocks during 1913-1918 is shown in figure 1.³ During this period, the stocks have assisted in reestablishing the price

¹ The result will be complicated by the advancing employment of engineering methods in the place of unorganized wildcatting; by a more scientific analysis of depletion data; and by the growing strength of the demands for petroleum products—all of which are tending toward stimulating increased prices for crude petroleum. The limitation in ultimate supply will also eventually come into bearing. (See fig. 8.) In this last connection consult David White, *The Unmined Supply of Petroleum in the United States*, *Journ. Soc. Auto. Eng.*, Vol. 4, 1919; also *The National Petroleum News*, Feb. 12, 1919, pp. 23-24; and J. E. Pogue, *An Interpretation of the Engine-Fuel Situation*, *Journ. Soc. Auto. Eng.*, Vol. 4, 1919, pp. 247-55; also *The National Petroleum News*, Feb. 12, 1919, pp. 18-21.

² Unfortunately, however, after great physical waste has taken place.

³ The size of the stocks is at once the result of, and the safeguard for, the lack of scientific control of the oil underground as obtaining under the present method of exploitation.

level in periods following overproduction, without having concomitantly modified the price advances during 1917-18 when the stocks have been filling a growing gap between production (including imports) and consumption. (See fig. 2.) As to the future, stocks may be expected to become smaller in relative size, but they will

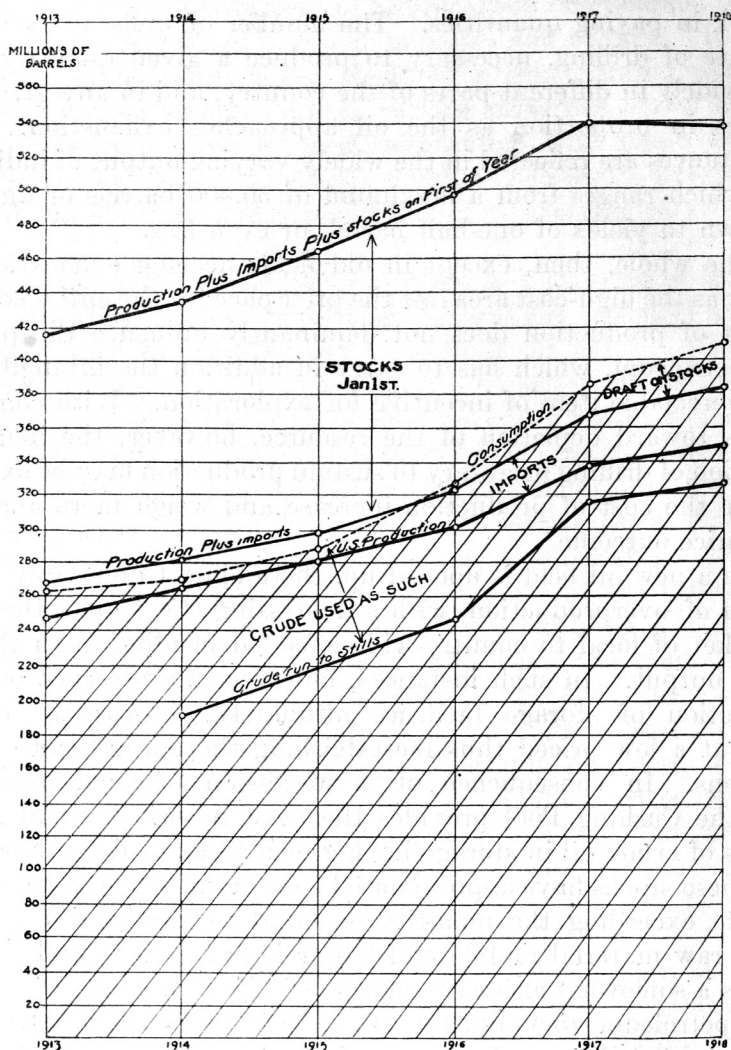


FIG. 1.—The crude petroleum situation in the United States, 1913-1918, showing the relation between marketed production, imports, stocks, refinery consumption, and total consumption. Data from United States Geological Survey, United States Bureau of Mines, and United States Fuel Administration.

continue to stand ready to expand under a depressed market and to contract when the price level is favorable to sale.

The transportation of crude petroleum.—Because of its liquidity and the large quantities to be handled, crude petroleum is transported with a facility and cheapness paralleled by no other bulky commodity. A network of pipe lines aggregating thousands of

miles in length is spread over much of the country, linking producing fields with refineries, markets, and seaports; while tank steamers serve to connect the Gulf ports with north Atlantic consuming centers. The pipe line has played an important rôle in developing

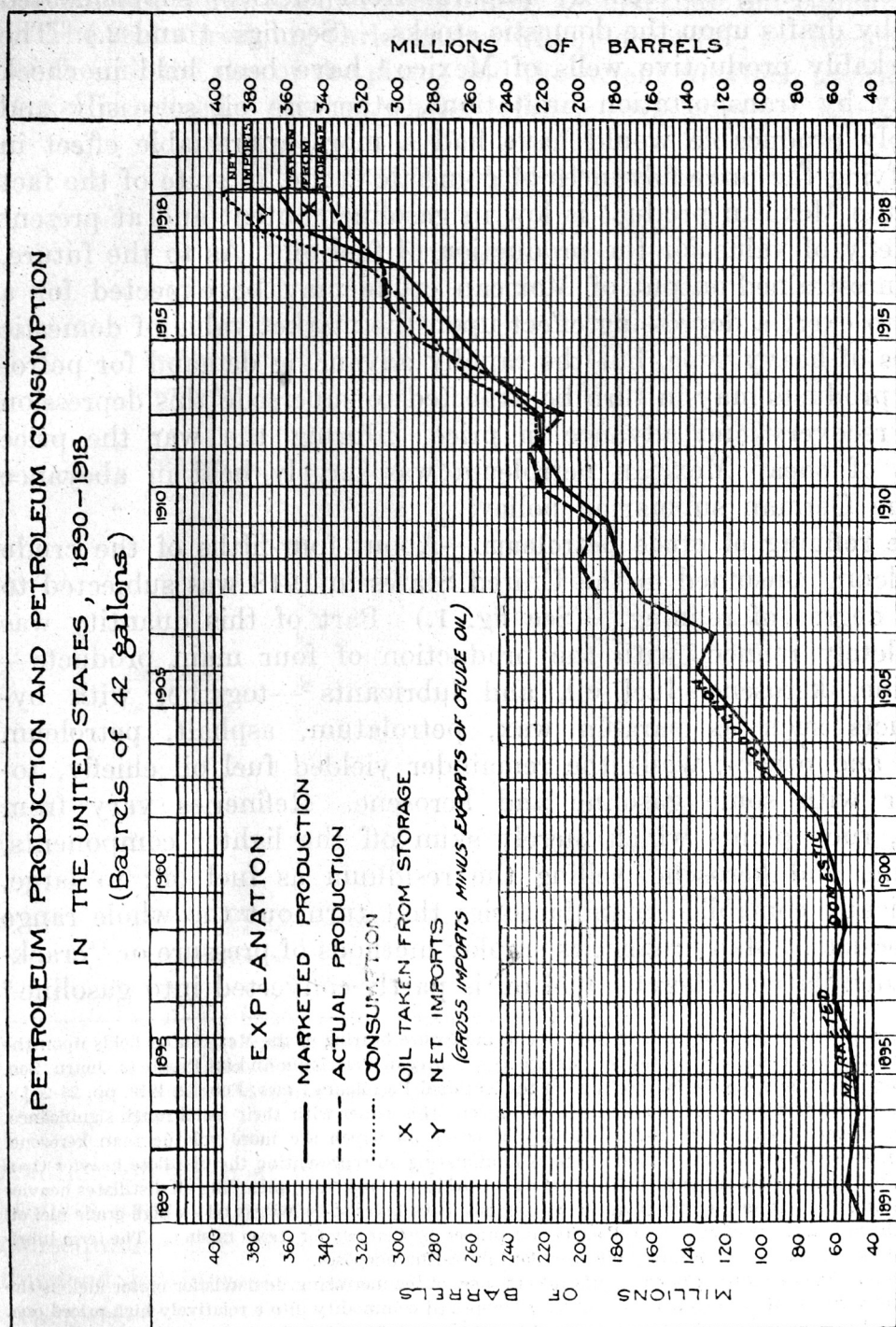


FIG. 2.—The growing gap between production and consumption of crude petroleum in the United States. After David White, United States Geological Survey.

the resource and tempering the cost of petroleum products, at the same time that it has inevitably exerted a control over the sale of crude, which from the nature of the case must be largely purchased by the pipe-line companies. The shipping shortage of 1917-1918

seriously impeded the coastwise movements of oil, necessarily augmenting in turn the pipe-line flow.

Imports of crude petroleum.—During 1913–1918, the United States has been consuming crude petroleum in excess of production, the difference being covered by imports from Mexico, supplemented later by drafts upon the domestic stocks. (See figs. 1 and 2.) The remarkably productive wells of Mexico¹ have been held in check merely by transportation limitations, otherwise oil so easily and cheaply producible would have had a more appreciable effect in modifying the price advances of domestic crude, in spite of the fact that the Mexican product is low in gasoline content and at present is chiefly of value for the production of fuel oil. As to the future, the unrestrained output of Mexican crude may be expected for a time to exert a depressing effect upon the market value of domestic crudes of heavy type, but the rapidly advancing demand for petroleum products may in turn be expected to supersede this depression with recovery and advance in price. During the war the price effect of cheap Mexican petroleum was largely held in abeyance by the German submarine policy.

The refining of crude petroleum.—About four-fifths of the crude petroleum consumed in the United States in 1918 was subjected to some degree of refining. (See fig. 1.) Part of this quantity was completely refined, with the production of four main products—gasoline, kerosene, fuel oil, and lubricants²—together with by-products such as paraffin wax, petrolatum, asphalt, petroleum coke, and others; while the remainder yielded fuel oil chiefly, together with some gasoline and kerosene. Refineries vary from small, rude plants which merely skim off the lighter components, gasoline and kerosene, selling the residuum as fuel oil; to large, chemically controlled manufactories that turn out the whole range of products. Many refineries employ methods of pressure or “cracking” distillation whereby fuel oil is partly converted into gasoline.³

¹ For a good and reliable account of the present and future bearing of the Mexican oil fields upon the domestic situation, consult E. DeGolyer, *Mexico as a Source of Petroleum and its Products*, Journ. Soc. Auto. Eng., Feb., 1919, pp. 74–76, reprinted in the *National Petroleum News*, Feb. 12, 1919, pp. 25–26.

² These are commercial terms and are used throughout this paper with their usual rough significance. Gasoline, as here used, covers those products of crude oil which are more volatile than kerosene. Kerosene, as here used, is the common type of illuminating oil representing the distillate heavier than gasoline, but lighter than gas or fuel oil. Fuel oil is used as a broad term, including all distillates heavier than illuminating oils and lighter than lubricating oils: it includes so-called gas oil—a high-grade fuel oil used in the manufacture of gas—as well as fuel oil proper used largely for steam raising. The term lubricating oil includes a variety of heavy oils used for lubricating purposes.

³ “Cracking” has a growing price significance in view of the increasing demands for motor fuel, as the process converts at fairly small cost a relatively low-priced commodity into a relatively high-priced one. “Cracking” has the possibility of seriously revising the economic status of petroleum refining. The economic aspects of “cracking” have been treated in some detail by E. W. Dean, *The Status of Refinery Practice with regard to Gasoline Production*, Journ. Soc. Auto. Eng., vol. 4, 1919; also the *National Petroleum News*, Feb. 12, 1919, p. 22; and by J. E. Pogue, *An Interpretation of the Engine-Fuel Situation*, previously cited.

The bulk and value of the refined products produced in the United States in 1918 are shown in figure 3, while other relationships of petroleum refining may be gathered from figures 4 and 5. Owing to their superior adaptability to present demands, the paraffin petroleum, in general, are more completely refined than the asphaltic oils.

The cost of refining varies rather widely according to the character of the oil, the size of the plant, and the extent to which the raw material is refined. On the whole, refining cost is only a fairly small

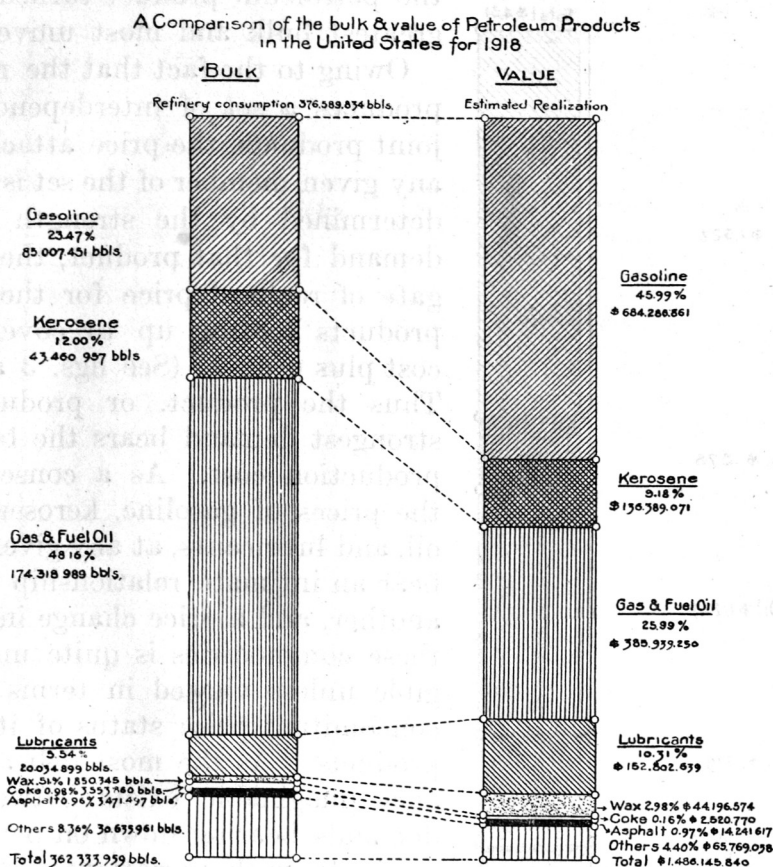


FIG. 3.—The bulk and value of the domestic production of petroleum products in 1918. Data from Bureau of Engineering, Oil Division, United States Fuel Administration. Refinery consumption includes crude plus materials rerun; values are estimated realizations and differ somewhat from the market values given in Fig. 23.

fraction of the cost of the crude petroleum employed, in many instances averaging around one-fourth to one-fifth of the latter. In consequence, the price of refined products is far more strongly influenced by increases in crude costs than by advances in refinery expenses.

On the whole, petroleum refining is backward both technologically and economically. Not only in many cases is refinery technique still in the rule-of-thumb stage, but many refineries, especially the small plants, have an inadequate system both in refining and disposing of

their products. In consequence, this product or that tends periodically to accumulate to the limit of storage in given refineries, leading to an overeagerness to dispose of the products approaching the storage limit. When a coincidence of accumulation, even though fortuitous, takes place in adjacent refineries, the effect is likely to be so accentuated and cumulative as to result in a local price depression out of all proportion to the magnitude of the cause. This outcome is particularly frequent and serious in respect to fuel oil,

the petroleum product turned out in greatest bulk and most universally.¹

Owing to the fact that the refinery produces a set of interdependent or joint products, the price attaching to any given member of the set is largely determined by the strength of the demand for that product, the aggregate of realized price for the set of products footing up to cover total cost plus profit. (See figs. 3 and 4.) Thus the product, or products, in strongest demand bears the brunt of production cost. As a consequence the prices of gasoline, kerosene, fuel oil, and lubricants, at any given time, bear an intimate relationship to one another, and a price change in one of these commodities is quite unintelligible unless viewed in terms of the concomitant price status of its joint products. As the most delicate balance imaginable exists between the demands bearing down on petroleum products, with variations depending upon seasons, industrial prosperity, and many other factors, the price fluctuations reflect a complexity of conditions perhaps unequalled in any

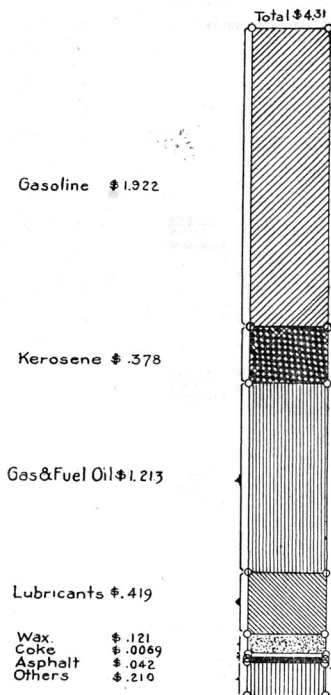


FIG. 4.—Estimated average returns per barrel of crude petroleum refined in 1918. Data from Bureau of Engineering, Oil Division, United States Fuel Administration.

other industry. A graphical, quantitative analysis of these factors, with special reference to the relation between consumption and stocks, is shown in figure 5. (See also figures 23 and 24.)

The distribution of petroleum products.—From the refineries, which are mostly located near the centers of consumption, petroleum products are distributed to the manifold points of use. A system of rail-

¹ It would scarcely be an exaggeration to say that two adjacent refiners, who happened at the same time to become a little panicky in regard to the rate at which fuel oil was piling up in their respective storage tanks, might, by repeated offerings of their output, give the appearance of a gross overproduction in respect to demand and depress the fuel-oil market through an appreciable section of the country.

THE RELATIONS BETWEEN THE PRODUCTION, CONSUMPTION EXPORTS & STOCKS OF PETROLEUM PRODUCTS IN THE UNITED STATES IN 1917-1918

1917. Data from U.S. Fuel Administration 1918

Jan Feb Mar Apr May June July Aug Sep Oct Nov Dec Jan Feb Mar Apr May June July Aug Sep Oct Nov Dec

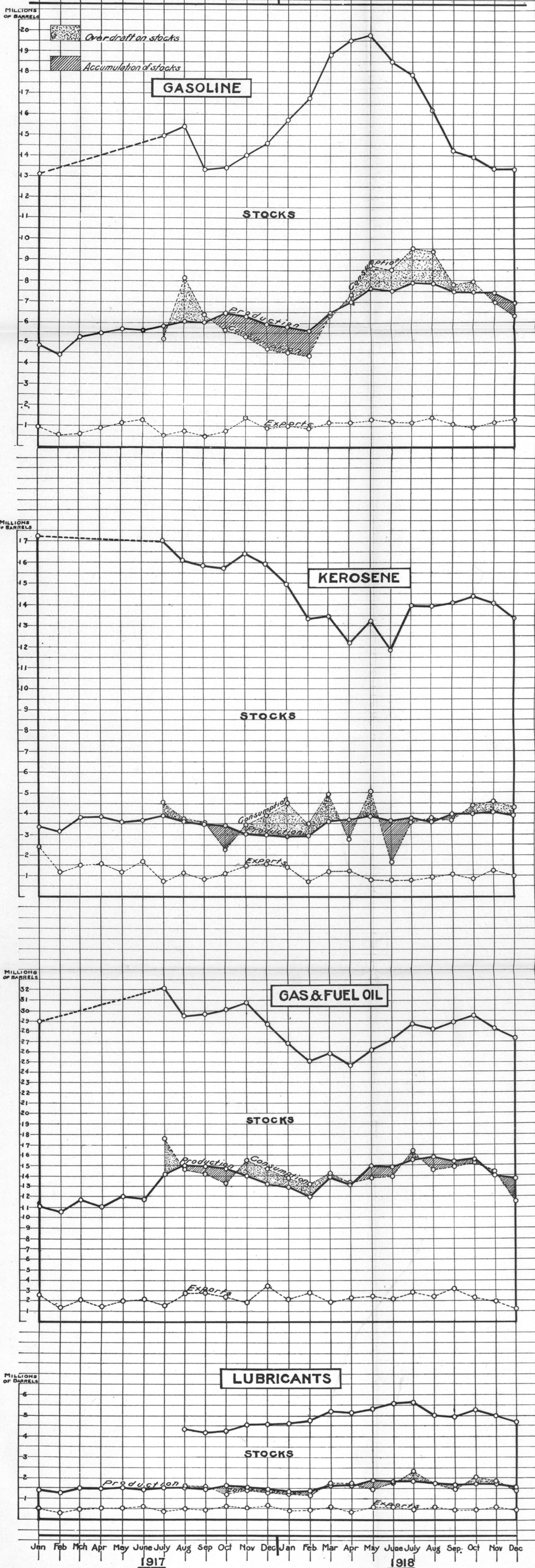


FIG. 5.—Diagram showing quantitatively the interplay between the main petroleum products, and giving in comparative form the relations between the production, consumption, stocks, and exports of gasoline, kerosene, fuel oil, and lubricants. Data from United States Bureau of Mines and United States Fuel Administration.

road tank cars, storage tanks, and tank wagons handles the gasoline and kerosene; tank cars move the fuel oil to industrial consumers; while lubricants are transferred mostly in barrels and tin containers. For export purposes, the smaller bulk container, such as the steel drum, the wooden barrel, and the familiar 5-gallon kerosene can, are more extensively used than in the domestic trade. Transportation cost, therefore, has an appreciable influence upon price, with the most marked effect in the case of fuel oil, the bulkiest product and at the same time usually the most distantly produced from the points of consumption. In export prices, the cost of containers plays an important part, the strong increases in 1918 being largely due to the sharp advance in cost of containers. The transportation shortage of 1917-18 had a striking influence upon the price of fuel oil, although gasoline and kerosene prices were scarcely affected by it.

Because of the peculiar conditions under which gasoline and kerosene are marketed in the United States, the prices of these products are not relatively uniform the country over. Prior to 1911, when the Standard Oil Co. of New Jersey, then producing over 80 per cent of the petroleum products of the country, was dissolved, the selling methods for gasoline and kerosene were fairly uniform, and there were no conspicuous price discrepancies and unbalanced fluctuations through the country. The dissolution decree, however, disintegrated this single large unit, whose operations primarily had been country-wide, into a number of smaller companies operating in arbitrarily determined territory with geographical rather than commercial boundaries. This action established a sectional influence upon the trend of the markets, and in spite of the upgrowth of other independent companies, which have come to do (1919) over half of the refining and nearly half of the marketing of the entire country, the Standard companies are each the dominant influence in its respective territory; and at prices determined by conditions within the separate units of the Standard group, the independents dispose of most of their products. As a holdover from this original arbitrary division of territory, and in spite of the diffusion of independent sales, the prices of gasoline and kerosene are uniform only throughout districts, and from district to district the prices and marketing practices vary in conspicuous degree. Thus it comes about that near the boundary lines between districts there are price discrepancies for gasoline, for example, as great as 2-3 cents a gallon.¹

¹ A map showing the 12 marketing districts of the United States is given opposite page 22 of Report on the Price of Gasoline in 1918, Federal Trade Commission, 1917.

A. G. Maguire, of the Oil Division of the Fuel Administration, has prepared a report on prices and marketing practices covering the distribution of gasoline and kerosene throughout the United States, which was submitted to the oil industry in 1919 for the purpose of bringing the issue under active consideration. "The report discusses the failure of the dissolution of the Standard Oil Co. of New Jersey to give desirable results in certain directions; describes the wide variance in marketing practices in the various districts of the country, with the recommendation that these be made uniform; and points out the variations in price in the various districts, suggesting a method of fixing a uniformly graded price on the basis of the price of gasoline at a nuclear point in Oklahoma."

The demand for gasoline.—The nature and growth of the demand for gasoline over the past six years is shown in figure 6. The unprecedented development of automobiles and trucks, not to mention tractors and aeroplanes, has increased the output of gasoline from a fraction of the quantity present in the crude produced to a figure exceeding the natural content of the crude supply. As shown in figure 6, which is made by plotting a fifth of the domestic production of crude petroleum (roughly the natural gasoline content) against the output of gasoline, the turning point in the economics of gasoline supply came in 1917 or thereabouts, and we are now obtaining more gasoline than the domestic crude naturally contains. This

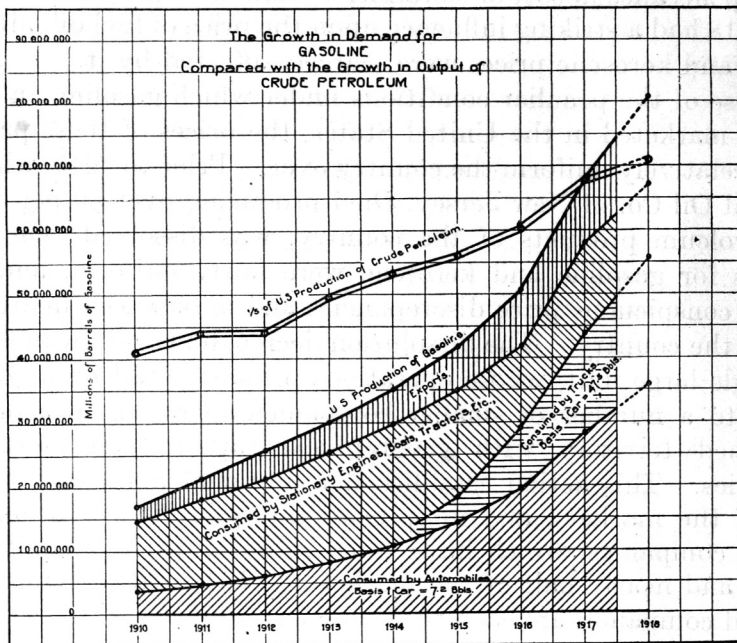


FIG. 6.—Graphical view of the demand for gasoline in the United States. Data from United States Geological Survey, United States Bureau of Mines, United States Fuel Administration, War Industries Board, and National Automobile Chamber of Commerce. Note relation between one-fifth of crude petroleum output (the natural gasoline content) and the actual production of gasoline.

excess is provided through such roundabout means of forcing gasoline production, as blending volatile gasoline made from natural gas with distillate (kerosene) too heavy alone to rank as gasoline, "cracking" fuel oil into gasoline, and lowering the volatility of commercial gasoline. The bearing of these circumstances upon gasoline prices is significant, though for the most part still potential.¹

The entire automotive industry is expanding so rapidly that it is open to question whether the means for producing motor fuel is keeping pace. As the price of gasoline has not reached the limits set

¹ The motor-fuel situation, with special reference to price, is presented in detail by J. E. Pogue, An Interpretation of the Engine-Fuel Situation, previously cited.

by its potential rivals (shale-oil distillate and alcohol), any shortage in gasoline supply that develops may be expected to give a marked impetus to price advance. Owing to recent increase in the price of its joint products, especially fuel oil and lubricants, gasoline during the war has not advanced significantly in price, even in the face of a marked advance in the cost of crude petroleum and transportation.

The demand for kerosene.—Kerosene is mostly used as an illuminant and for many years about half of the output has been exported to accommodate the quantity produced in excess of domestic requirements.¹ In contradistinction to the price of its joint products, therefore, the price of kerosene has been strongly, if not dominantly, influenced by foreign market conditions. In the United States a significant fraction of the kerosene employed is used in stoves for heating and cooking, which adds to the seasonal variation in demand, a factor likewise effective in the case of gasoline and fuel oil, as shown graphically in figure 5. The coal shortage of 1917–18 increased the demand for fuel kerosene to the point of contributing a price influence.

Recently a new demand has been bearing down upon kerosene, which has not yet accumulated to the extent of affecting the price very appreciably, although bidding fair to have a marked effect in the near future. Reference is had to the increasing demand for motor fuel, which is encroaching upon kerosene through two avenues: The decreasing volatility of gasoline is drawing an increasing fraction of potential kerosene into the gasoline supply, while "cracking" processes are under development which will (if commercially operated) turn an increasing quantity of kerosene directly into gasoline. Thus the motor-fuel demand may soon, in the one way or the other, come to dominate the price determination of kerosene, with the possibility of partly, if not largely, withdrawing kerosene in its present form from the market. This prospect imposes a serious problem upon the automotive interests, as the tractor industry largely, and the motor-truck industry partly, is proceeding to develop kerosene engines on the apparent assumption that the present price ratio of kerosene to gasoline is a persistent feature in the motor-fuel situation.² The very development designed to take advantage of this price disparity will tend to nullify it.

The demand for fuel oil.—About half of the refinery output in the United States is fuel oil, which is used principally for steam raising in the place of coal, and to a less extent in metallurgical furnaces and for the manufacture of gas. The southwestern and far-western portions of the United States, where coal is lacking, are largely dependent

¹ Kerosene is necessarily produced along with gasoline and fuel oil, hence its disposition becomes necessary irrespective of demand.

² Kerosene is now about half the price of gasoline. (See fig. 23.)

upon fuel oil for their heat and power; naval and shipping operations on both oceans draw much of their energy from this substance; while the war activity has led to a conspicuous increase in fuel-oil utilization in the industrial regions of the northeastern portion of the country. The demand for fuel oil fluctuates according to the status of industrial activity, with minor variations arising from the seasons and the strength of the related demands for the joint products. This interplay, especially between fuel oil and gasoline, is very significant. The industrial quickening during the war greatly strengthened the demand for fuel oil, especially in the East, while the coal and transportation shortage of 1917-18 conspired to send the open-market price to unprecedented heights. Since much of the fuel oil is sold on contract and conditions of accumulating storage often lead to hurried offerings of the product, the market prices of fuel oil are not good criteria of the actual conditions. The price of fuel oil, in general, follows closely the price of the crude from which it is made, and is limited in its advances, except in special instances, by the cost at which coal can be procured.¹

Fuel oil offers such a range of advantages over coal for ocean shipping, and such high economy can be effected through the use of the heavy oil motor, that the world's shipping is rapidly turning or planning to turn to this ideal fuel. In view of the limited nature of the resource, this tendency, once under full swing, may be expected to bring an advance in price such as will largely withdraw the product from its industrial fuel rôle, especially since the demand for gasoline at the same time will be pulling more and more heavily upon fuel oil through the avenue of "cracking." In fact, so soon as fuel oil is fairly caught between the pincers of this twofold motor demand, its availability for purely industrial purposes on land in competition with coal will rapidly become a thing of the past. Fuel oil to the present has remained cheap only because of its production in advance of the growth of a demand adjusted to its real possibilities.

The demand for lubricants.—Lubricating oils are energy conservers, used in far smaller quantities than fuel. In consequence of their essential character and specialized rôle, lubricants command a good price, tempered, however, by the fact that lubricating values are still unextracted from most of the crude oil produced. The demand for lubricants, while dependent upon the state of industrial activity, is not subject to marked variations and is increasing slowly and regularly with the growth of industrialism. The rapid development of the automotive industry has created a new and growing field for lubricants, which represents the chief expansion in recent

¹ An interesting table, showing (at pre-war rates) the prices at which fuel oil would still compete with various steaming coals, is given in Johnson and Huntley, *Principles of Oil and Gas Production*, New York, 1916, p. 7. The relative prices of fuel oil and coal in California are discussed in Report of the Committee on Petroleum, California State Council of Defense, Sacramento, 1917, pp. 157-158.

years. Owing to abundant sale of lubricants in small bulk, the cost of containers and distribution enters more rigorously into price than is true in respect to the bulkier products.

The demand for by-products.—The field of petroleum by-products is largely undeveloped, although some 200 substances representing about 9 per cent of the value of the main products are now being produced. (See fig. 3.) These products fall into two classes—crude by-products, such as coke, road oil, and paraffin wax; and highly fabricated by-products, such as vaseline, nujol, and others. The prices of petroleum by-products are largely unaffected by the special factors that weigh so heavily in the price outcome of gasoline, kerosene, fuel oil, and lubricants, and more nearly follow the price course of commodities in general.

Miscellaneous special price factors.—The foregoing paragraphs go to show that the prices of petroleum products are the result of a great complexity of special factors peculiar to the oil industry, in addition to other factors common to all industrial activities, of which no remark was made on the assumption that these are sufficiently in mind. Besides, there are a number of more intangible factors of some weight, which should not be passed over without mention. Thus the basic character of petroleum products as accelerators of industrialism gives them a pivotal bearing upon modern affairs, with a price effect held in abeyance only by the lavishness with which the petroleum resource has been led to produce. Then the relatively easy fabrication of the raw material into its main products, coupled with the rapid growth in crude production, has sustained a widening spread of quantity production, together with a laggard upgrowth of by-product possibilities; a margin of profit being easy to maintain at prices broadly following the cost of crude, without special attention to coordination and scientific control. Again, the state of integration of the industry, whereby there is prevailingly a sharp break between small-unit mining and large-unit handling activities, accentuates the discordance that obtains between production and balanced demand. In spite of the most elaborate methods of transportation and marketing, the petroleum industry in its production and refining aspects is heterogeneous and makes imperfect utilization of modern technology, with the result that the fabrication factor (see figure 7) is unduly low.

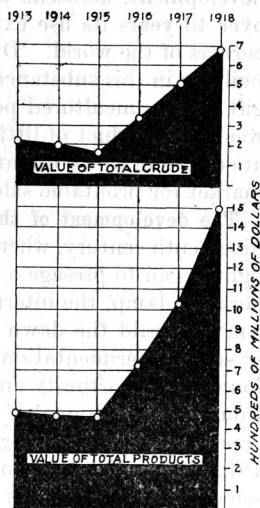


FIG. 7.—The increase in values resulting from manufacture (fabrication factor) in the petroleum industry, 1913-1918.

COMMERCIAL HISTORY OF THE PETROLEUM INDUSTRY.

The era of kerosene dominance.—The petroleum industry in America had its beginning in 1859, when the famous Drake well struck oil on Oil Creek, Pa. At that time an illuminating oil distilled from coal and called "coal oil" was in general use throughout the country. Crude oil was not itself adapted to illuminating purposes, but it was soon discovered that a satisfactory illuminant could be distilled from it, and thus kerosene came on the market and soon replaced coal oil. Although other products were produced from crude oil, and lubricants found a growing demand to justify their development, kerosene became the chief petroleum product and for over 40 years its use expanded until it penetrated to the uttermost corners of the world. During this period a notable foreign trade was built up in this substance, which has been called "America's greatest gift to the uncultured peoples of the globe."¹ Gasoline, the while, was a by-product of little value, necessarily produced, and instances are common where quantities were literally thrown away in want of a market for profitable sale.

The development of the gasoline motor.—Toward the close of the nineteenth century, when the incandescent gas mantle and the electric light began to presage a limit to the easy expansion in the use of the kerosene lamp, the internal-combustion engine appeared on the horizon to herald the dawn of the motorized age. After a dozen years or so of experimentation and casting about, the automotive industry found its opportunity and entered upon a career of expansion, which would be sensational if not so familiar. The demand for gasoline created in this way brought this product rapidly to the front. Around 1912 the value of the country's gasoline output passed that of kerosene, and gasoline then took the lead and soon became "the main prop to the whole cost structure of petroleum refining." (See figs. 3, 4, and 23.) At the same time, with the tremendous increase in the output of the Mid-Continent and California fields, fuel oil came on the market in ever-increasing quantities, engaging the budding industrialism of the Pacific Slope and the Southwestern States on an oil-fuel basis.

The Cushing depression.—Inspired by the ease of production arising from the peculiar geological occurrence of oil, the production of crude petroleum, especially since 1900, has been increasing at a notable rate. (See fig. 2.) Reversing the situation in the normal run of resources, oil production has consistently set the pace for consumption, causing all manner of extravagance and keeping well in the lead of balanced demand. Successive discoveries of rich pools have followed with sufficient frequency to maintain a lavishness of supply,

¹ See Bull. 102, pt. 6, U. S. National Museum, 1918, pp. 19-21. An interesting, nontechnical view of the development of the oil industry is also given by W. S. Tower in *The Story of Oil*, 1909.

but with a rough periodicity that caused the growth in output to proceed in a series of ever-widening circles—overproduction, price depression, retardation of output, price recovery, etc.—until at length with an unprecedented outburst, the growth culminated in an unparalleled output in the Mid-Continent field in general and its notorious Cushing Pool¹ in particular. Between June, 1914, and April, 1915, when the wells of the Cushing Pool attained a maximum production of some 300,000 barrels daily (over one-third of the output of the entire country), the yield in high-grade oil of this one area dominated the petroleum situation in the entire United States and caused a marked depression in crude prices the country over. With the abrupt decline in the Cushing Pool toward the end of 1915, and the purchase and storage of millions of barrels of the surplus output, there came a reaction in the form of a recovery of confidence, an advance in price, and a renewal of aggressive wildcatting.

Although the country's output of petroleum has been increasing, the demands have been recently enlarging still more rapidly, with the development since 1915 of a gap between production and consumption that has only been filled by imports from Mexico and drafts upon the accumulated stocks. (See figs. 1 and 2.) Cushing marks the turning point in the oil situation in the United States. Heretofore, the economic pressure was in the nature of an oversupply seeking an outlet; henceforth a pressure new to the economics of oil is due to develop in the opposite direction. Competitive demand will become the controlling factor; there will be less overindulgence in consumption; the more essential directions of application will be sustained with higher efficiency. In support of resource limitations (see figs. 8 and 9) the recuperative force of price increase will tend to develop, further reducing overindulgence and waste and calling into play activities of a supporting character in other resources. Strength of demand, and not cost of production, will sound the dominant note in the oil prices of the future.²

The war and the period of fuel-oil dominance.—When the United States entered the war in April, 1917, the petroleum situation was well advanced into the era of gasoline dominance, at the same time that the output of domestic petroleum was beginning to lag conspicuously behind the country's consumption. The war brought increased demands for petroleum products to sustain the accelerated industrial and military activities of the allied cause, and under the coal shortage

¹ The Cushing Pool is in Oklahoma, in the Mid-Continent field, and proved to be the most productive occurrence of light oil that the world has seen. For a geologic account of the Cushing Pool consult Carl H. Beal, *Geologic Structure in the Cushing Oil and Gas Field, Oklahoma*, Bull. 658, U. S. Geological Survey, 1917.

² This began to happen in 1915, when following immediately upon the culmination of the Cushing orgy, the price of gasoline abruptly advanced, causing country-wide concern and inspiring Congress to order an investigation through the Federal Trade Commission. (See Report on the Price of Gasoline in 1915, Federal Trade Commission, Washington, 1917.)

and transportation congestion of 1917-18 these demands were gravely accentuated by a policy of encouraging the substitution of fuel oil in the place of coal. In result, the demands for fuel oil increased apace, until there was a shortage of this commodity, accompanied by a general doubling in its price. Fuel oil, for the time being, took the lead and set the pace in the economics of the situation; gasoline became of secondary importance, produced and consumed of necessity as such; even the flow of fuel oil through the avenue of cracking was partly stopped. Under the reflected stimulus of an unprecedented price

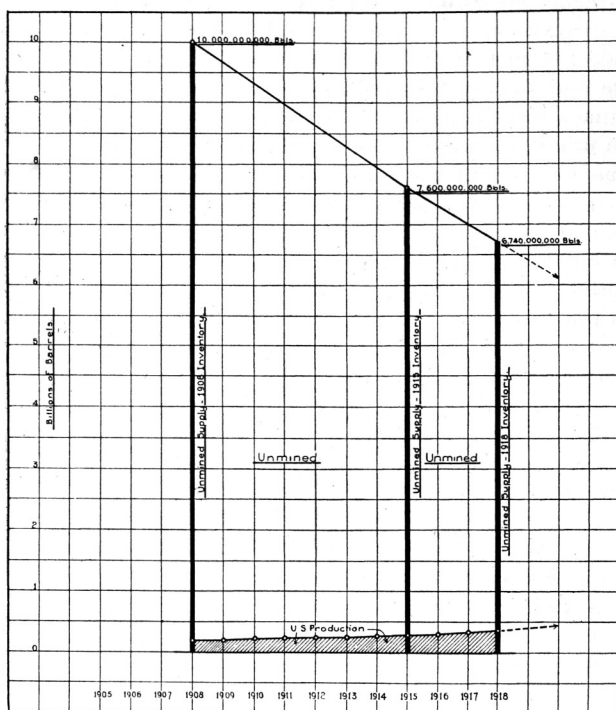


FIG. 8.—The estimated unmined supply of crude petroleum in the United States. Data from United States Geological Survey. Note in connection with Fig. 9.

level for fuel oil and in response to a not altogether unsophisticated feeling in the industry that a serious shortage in crude supply was impending, the prices of crude the country over became sympathetically affected and started on an upward climb. Public support was rapidly enlisted in respect to a tendency commonly conceived to be needed as a stimulus to production.

The emergency control.—In such manner was the situation shaping up in the summer of 1918. In the meantime the Oil Division of the United States Fuel Administration had been established with the appointment, on January 10, 1918, of M. L. Requa as general director.

Acting under the authority of the food and fuel control act of August 10, 1917,¹ the Oil Division had broad powers of control which were never called fully into action, owing to the successful development of a policy of cooperation between the oil industry and the Fuel Administration whereby the oil industry, acting through the

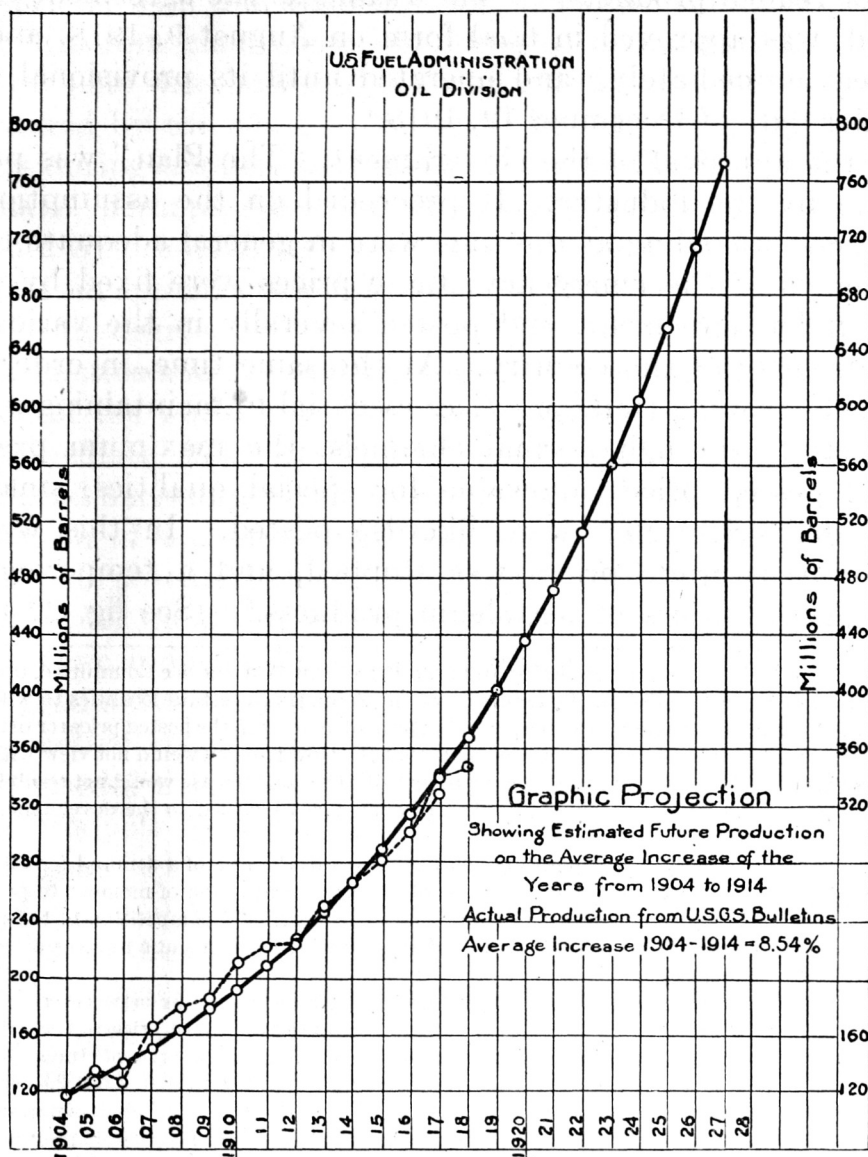


FIG. 9.—The estimated future production of crude petroleum in the United States on the basis of the recent rate of increase. The growth in output indicated can scarcely be expected in view of the size of the reserve (see Fig. 8), which means that increasing imports and increasing efficiency in utilization must come into play.

National Petroleum War Service Committee, became self-governing in terms of the national emergency.²

¹ "An act to provide further for the national security and defense by encouraging the production, conserving the supply, and controlling the distribution of food products and fuel." This was the so-called Lever Act.

² And so I believe that the oil industry can govern wisely and well, if it will; that it can formulate its own rules and regulations far more satisfactorily by voluntary effort than through Government mandate * * * I have gone on record as believing that a free people, schooled in democracy, could successfully police their own industries as a voluntary spontaneous tribute to the form of government under which they live * * *. (From addresses by M. L. Requa, delivered on July 12, 1918, and July 22, 1918, respectively.)

Because of the tendency of oil prices in the early part of 1918 to advance more sharply than appeared to be justified as a stimulant to production, the Oil Division¹ engaged the oil industry in a plan "to stabilize prices and maintain uninterrupted flow of crude," which included tacit or implied voluntary agreements restricting prices for refined products.² "The Plan," as the agreement came to be called, was approved in final form on August 9, 1918, and went into effect immediately,³ and operated until its provisional relaxation under date of December 12, 1918.⁴

With the approval of the Government, "The Plan" was put into execution by the industry. It proceeded on the assumption that crude prices prevailing at the time were in general adequate to meet the demands of the emergency; these prices were fixed by the industry, under agreement, and posted severally in the various producing districts of the country. At the same time, in order to accommodate existing trade practices essential to maintaining a steady flow of crude through normal channels, the maximum premiums over the posted prices allowable for special qualities, small lots, unusual deliveries, etc., were likewise posted. In this wise, the acceleration in crude prices was stopped, and a tempering effect exerted on the prices of petroleum products.⁵ (See fig. 22.)

¹ In a letter from M. L. Requa to the chairman of the Petroleum War Service Committee, under date of May 17, 1918, attention was called to the tendency of oil producers in certain localities to withhold production in anticipation of increased prices, either in the form of increase in the posted prices or in the amount of bonus paid. In this letter the statement was made that the Government would not view with approval any further advance in the price of crude oil, owing to its belief that an increase would not result in material additions in output. This was the beginning of correspondence which led to the development of "The Plan" as described below.

² * * * the law of supply and demand has broken down in the face of a demand far exceeding the available supply * * * I do not believe there would be any stimulation of moment to production of petroleum by an increase in the price of crude oil * * * unrestricted competition in the purchase of petroleum is not in the national interest * * * (Remarks by M. L. Requa at a meeting of the National Petroleum War Service Committee on July 12, 1918.)

The proposal that I am making is that stabilized differentials be created as between crude petroleum and finished products at the refinery and as between refinery prices and the price to the ultimate consumer; that these differentials be maintained and move in unison with the price of crude; that if necessary the volume of business be frozen and new business equitably distributed; that the old theory of competition give way for the war period to a condition of mutual helpfulness, in behalf of national welfare, and that all these things be brought about by the voluntary action of the industry in harmonious cooperation with the Fuel Administration. (The Necessity for Government Control of the Oil Industry, an address delivered by M. L. Requa in Tulsa, Okla., on July 22, 1918.)

³ The details of the agreement are fully given in a small pamphlet entitled "The Plan," published by the National Petroleum War Service Committee in New York, August 18, 1918.

⁴ According to letter from M. L. Requa to A. C. Bedford, chairman of the National Petroleum War Service Committee, on file in the Oil Division, U. S. Fuel Administration.

⁵ As "The Plan," as an example of resource administration, has an interest apart from its application in the specific case of oil, it may be worth while to quote at some length from it pages: "I have read your letter with careful attention, and note that the proposals are submitted for the purpose of: (1) Stabilizing the price paid for crude oil, and (2) to maintain the continuous and uninterrupted flow of crude oil in its present channels, in so far as is practicable and just to the interests involved through the voluntary action and cooperation of the industry itself. I note that it is the intention of the industry voluntarily to place these suggestions in force and continue the same until November 1, 1918, and thereafter for such period as may be determined by the National Petroleum War Service Committee and approved by the Fuel Administration. In expressing to you the approval of the Fuel Administration of the effort of the industry to bring about the much-desired stabilization, I believe that there are certain factors which I should point out, so that there may be no misconception on the part of the industry as a whole. I want first to say

This simple and indirect control was all in the way of governmental influence ¹ that fell directly upon the course of prices in the oil industry, with the exception of stabilized prices for allied and governmental purchases agreed upon between the oil industry and the Fuel Administration. These prices were based upon prevailing domestic prices, with due allowance for specifications more specialized or more rigorous than those obtaining in domestic sales.² On the whole, the plan was successful in its operation. Its effectiveness may be measured by the contrast between the price curves of petroleum products during the period of its operation and before that time. It could have, perhaps, been advantageously enlarged to include the petroleum by-products, especially paraffin wax; while the price of lubricants, in special instances, seems to have been escaped its influence to some degree.

The armistice and the advancement of the motorized age.—The termination of the world war, with the armistice of November 11, had little immediate effect upon the course of petroleum prices, owing to the initial uncertainties as to the outcome coupled with the natural continuation of war stress and war regulations for an interval following. The potential effects to be felt in 1919, however, were quite significant; for the disintegration of the vast military program threw the petroleum industry back upon a peace-time footing, with an increased productive capacity facing a period of industrial sluggishness pending active recuperation. But these conditions, so serious in other industrial fields, were tempered in respect to most of the petroleum products by virtue of their essential character, although in early 1919 the fuel-oil market slumped badly from the falling off of the industrial demand, while gasoline faced the anomalous position of having to support the fuel-oil decline at the same time that its own demand was suffering a temporary relapse; also the mild season had its due effect, favorable in respect to the demand for gasoline, unfavorable to the disposal of fuel oil and kerosene.

that it is the understanding of this department that the premiums mentioned are to be maximum and are not to be paid unless absolutely necessary; are not to be used in justification for a demand for increased prices for refined products; and that prices above existing posted prices, if justified at all, can only be so upon the score of existing trade practices making such premiums necessary to permit the small purchaser to secure his crude. If Government control and direction finally follows as a national need, premiums, I believe, will be entirely wiped out, as present posted prices are in themselves ample to stimulate and encourage production. Broadly speaking, it is the hope of the Fuel Administration Oil Division that further advances in finished products will not be necessary; but should it prove that this is not the case it means that such proof must be carefully, completely, and accurately made and presented to this department before any acquiescence or approval can be expected. I am assuming, therefore, that the premiums mentioned will not necessarily be paid in all cases; that they fairly represent premiums already established; and that they can be paid and a satisfactory profit realized without affecting prices of finished products." (Letter by M. L. Requa, as published in "The Plan," pp. 15-17.)

¹ The entire lot of governmental orders and regulations relating to petroleum, its products, and natural gas may be found contained in 13 pages (pp. 579-591) of a publication entitled, "General Orders, Regulations, and Rulings of the United States Fuel Administration, Washington, 1919."

² The prices may be consulted, by any one interested, in the files of the Fuel Administration. They are not published here, because they shed no light that is not likewise shown by the run of domestic prices.

With the recuperation of industrial activities in the United States, interesting price developments in respect to petroleum products may be expected. The situation here indeed is unique and affords some very important problems in national administration—problems which, if improperly apprehended or falsely interpreted, have promise of trouble. (See figs. 6 and 8.) The prospective development of the automotive industry—automobiles, trucks, tractors, aeroplanes, motor vessels—is so imposing that the demand for motor fuel is likely to create an unprecedented price impetus (especially if shortages develop), out of proportion even to the price advance impelled by the natural increases in production costs as more wells and deeper wells become necessary to support the production of crude. In such event, and especially if price regulation should appear desirable, a false handling of prices at this critical juncture would run the risk of retarding the then needed development of supporting resources such as shale oil, which even without a misplay may find themselves unable to come into action with sufficient celerity to sustain an unbroken advance of the motorized age.

THE PRICE RECORD.

General explanation.—Having in mind the principal price factors peculiar to petroleum and the chief events that have transpired in the industry during the past six years, we may examine the run of prices during that period with a view to observing the relationships of the several prices to one another, to the circumstances having a price connection, and to prices in general. In the following pages are presented in graphical and tabular form the price data requisite to this purpose, arranged to facilitate analysis and comparison.

Tables 1, 2, and 3 show the grades, markets, and quotations upon which the graphical presentation of the situation is based. Five grades of crude petroleum; gasoline and kerosene at five marketing centers, together with export kerosene at New York; fuel oil at five characteristic centers near the points of production; five lubricating oils at New York; and two by-products, paraffin wax and petrolatum, at New York, are given as representative of the situation.

Figures 10, 12, 14, 16, 18, and 21 are curves of actual prices and show the actual fluctuations in price from month to month. They require no explanation other than the remark that they do not show the daily fluctuations in price, as these minor changes for purposes of simplification are leveled in a monthly average.

Figures 11, 13, 15, 17, 19, and 20 are curves of relative prices and show the price fluctuations on a percentage basis so that the price curves may be directly comparable, both among themselves and in respect to the price curves of the whole range of commodities covered in this series of price studies. The relatives were calculated from the

actuals according to a uniform method used in all the bulletins of the series, whereby the products were individually averaged on the basis of their pre-war level. Since the inquiry centers about the effect of the war upon prices, the relatives were designed, when charted, to show the movement of prices away from the pre-war level. This effect was produced by treating the average of the actual prices for the 12 months preceding the outbreak of the war (July, 1913, to June, 1914) as equal to 100, and reducing the actual prices for each month from January, 1913, to December, 1918 to the form of relative prices on that scale. Thus, for example, if the selling price of a given unit of a product averaged \$2 in the year ending June 30, 1914, and fell to \$1.80 in January, 1915, the relative price of that product for that month would be 90; if the price rose to \$4 in June, 1918, the relative price would be 200.

For purposes of charting a composite of prices, to make the output of the petroleum industry as a whole comparable with outside commodities, the prices of the various products were weighted according to the size of their 1917 production plus imports, averaged in together and reduced to relatives.¹ This procedure gives a series of "index numbers" susceptible to direct comparison with index numbers similarly prepared for other industrial fields. (See fig. 22.)

The price data are taken from trade journals, governmental reports, and from information supplied directly from the industry, predominantly the first. (See Tables 1, 2, and 3.) The quotations are for the most part market prices, which do not necessarily correspond with the prices realized. Although realized prices would give a more rigorously scientific basis for the present study, they are not to be got without a revision of accounting within the industry itself and a statistical investigation beyond the scope of the present inquiry. The data used, however, are thought to reflect the situation with reasonable accuracy and to be sufficient for all practical purposes, provided a specific exactitude in the case of individual items is not expected. For purposes of comparison and as showing relationships, the basic data, as imperfect as they are, may well be adequate.

The prices of crude petroleum.—The posted prices² of crude petroleum in five fields—Pennsylvania, Illinois, Mid-Continent, Gulf, and

The year 1917 was selected as the "weighting year" so that wartime conditions might be reflected. Figures for 1918 would have been more typical of the situation, but such data were unavailable for many commodities when the bulletins were being prepared.

² A considerable quantity of crude, especially that bought by small companies, is purchased at a premium over the posted, or published, price. There is no practical way, at present, of introducing this factor, as the quantities so changing hands are not centrally reported. It is felt, however, that the relationships presented are not seriously impaired by this omission.

"The greater part of the petroleum produced is purchased by the pipe-line companies. Nominally these companies transport it at tariff rates, but actually they buy the oil outright, paying the market (posted) rate which is supposed to be the delivered price at the refinery less transportation. The price is determined by the announcement (posting) by one of the purchasing concerns in the district of the price it will pay. When competition exists the other purchasing concerns generally follow at once. To the base price may be

California—are given as typical of the general situation. The run of these prices is charted separately in figure 10, while a weighted average reduced to a relative basis is given in figure 11.

There were six major events in the price history of crude in the six-year period of 1913–1918, to which the four crudes east of the Rocky Mountains were closely sympathetic, with California less definitely reactive.¹ These may be listed separately as outstanding features, to which all other circumstances are subordinate, and are to be held clearly in mind as carrying a dominating influence into the price relations of petroleum products.

1. *The 1913 period of normal price advance.*—The year 1913, together with the early months of 1914, was characterized by a normal advance in crude prices, resulting in general from the rapidly increasing demand for petroleum, and in particular from a tendency toward declining production in the Pennsylvania field, which reacted to bring a rise in price and inclined to set the pace for the rest of the country.²

2. *The Cushing overproduction of 1914–15.*—The strengthening markets of 1913 stimulated a country-wide drilling campaign, which culminated in the tapping of the deep sands of the Cushing Pool in Oklahoma in April, 1914. Production “went wild”; oil in endless quantities poured forth from a multitude of wells drilled in frenzied haste. Excepting in California, the bottom dropped out of the entire crude-oil market. The price slump was unprecedented in the history of the oil industry.³ (See figs. 22, 23, and 24.) The effect upon the petroleum industry of the outbreak of the European war in July, 1914, was largely drowned in the flood of Cushing oil.⁴

3. *The recovery of 1915–16.*—Each action has its reaction and Cushing proved no exception. By August, 1915, Cushing, while

added certain premiums, and from it are made certain deductions for sand, water, etc. The deductions are generally alike for all. The premiums are: 1. Premium for quality * * * 2. Premium for delivery * * * 3. Premium for credit * * * 4. Inter-company premium * * * During the past year * * * marketers have sought refiners with increasing insistence and delivery, not price, became the important question between them. The great bulk of the stored oil of the country is in the hands of a comparatively few companies which have been able to supply the shortage of receipts by drawing on reserves. Refiners without reserve storage had no such opportunity and have become more and more insistent in their demands upon the producers, with the natural result of a rise in the price of crude.” (From a report, Prices of Petroleum Products, made by Sanderson & Porter to the Oil Division under date of Aug. 24, 1918.

¹ It should be borne in mind that the petroleum situation in California stands rather sharply apart from the rest of the country, owing chiefly to the geographic and commercial individuality of that section.

² Because of the age of the field and the high quality of the oil, the Pennsylvania crude market has a far-reaching influence upon the crude market in general.

³ The Mid-Continent market, determined to an overwhelming extent by the course of the Cushing field, for about 15 months held the balance of power of the country's general petroleum destinies, and so long as the boundless resources at Cushing were permitted to be taxed to such unsparing limits, in one of the most frenzied drilling campaigns in the country's industry, there could be no reasonable hope for relief from the general impairment of fortunes. The effect was emphasized by the restrictions and complications attending the foreign refined trade during the last year. (Oil, Paint, and Drug Reporter, Feb. 14, 1916.)

⁴ The Cushing incident is probably the most notorious example of unbridled production and waste in the history of this country.

Fig. 10.

ACTUAL PRICES OF CRUDE PETROLEUM

BY MONTHS
JANUARY 1913 TO DECEMBER 1918
PER BARREL

..... At Wells Illinois
—— " Pennsylvania
- - - - " Mid Continent.
—○— " Gulf Field
- - - - " California 20°

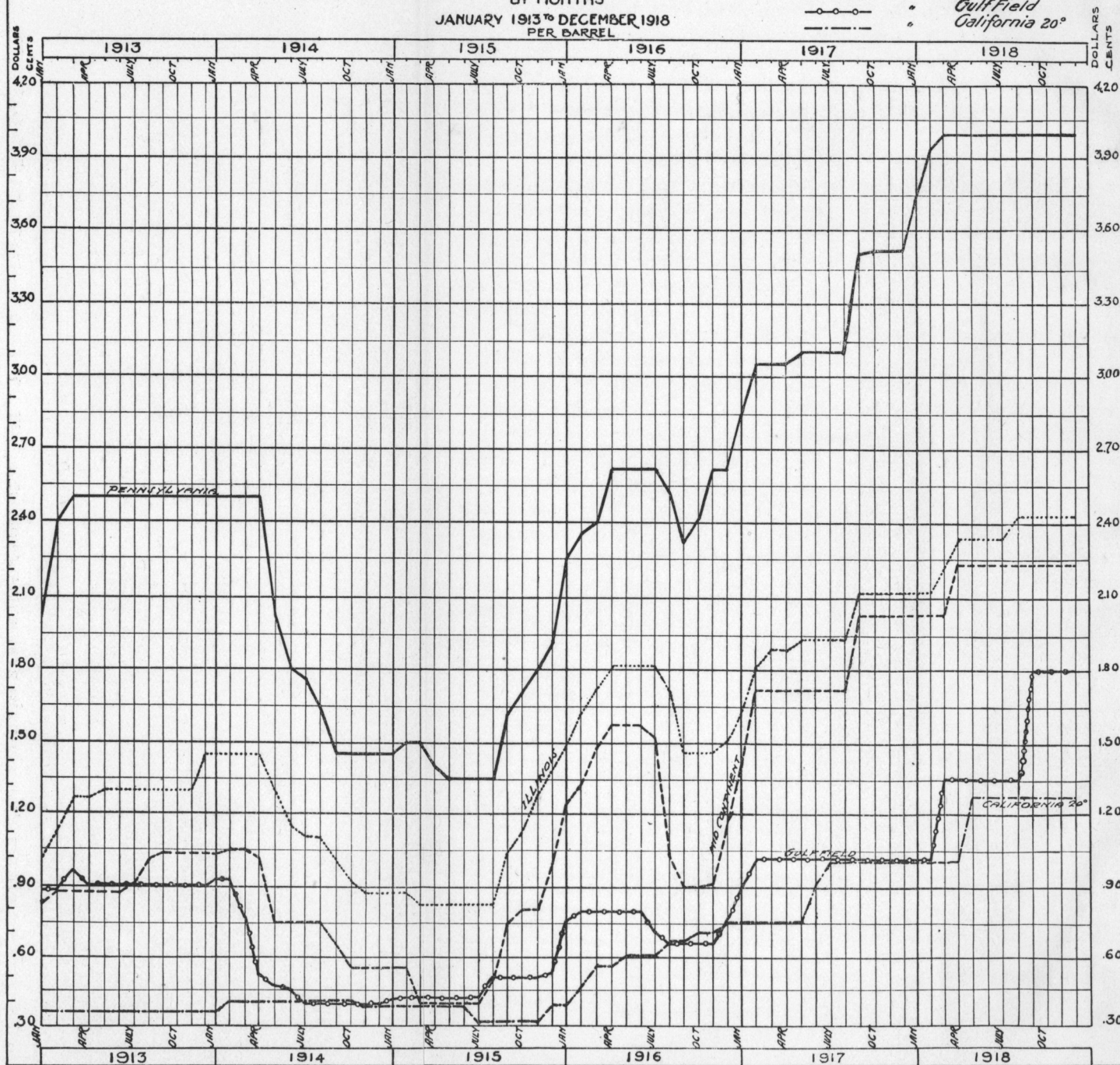


Fig. 10.—Actual market prices of crude petroleum in five fields.

still productive, had run its course. Encouraged by an ever-accelerating demand for gasoline, and by the purchase and removal from the open market of large quantities of surplus Cushing crude, prices recuperated with even greater rapidity than they had declined and by the end of 1915 the market was just surmounting its pre-Cushing level. This advance continued through the first quarter of 1916, but after the manner of such things overreached itself. Overstimulated drilling, especially in the Mid-Continent field, brought a surplus production with a corresponding price depression, far less serious, however, than the disastrous overproduction of the Cushing days.

4. *The minor slump of 1916.*—The recovery from Cushing, then, was too rapid. There came a temporary relapse, strongest in Mid-Continent prices, and the last half of 1916 saw a repetition of the Cushing depression on a minor scale. With the turn into 1917, however, the recovery was complete.

5. *The war stimulus of 1917-18.*—Under the stimulus of war conditions—strengthening demands, increasing production costs, eagerness for insuring adequate increases in output, and the general atmosphere of increasing prices—the prices of crude advanced at intervals the country over, until in early 1918 they attained a height in general roughly double the prewar level. The reaction was uniform and singularly coincident on the part of the five crudes charted, as shown in figure 10.

6. *The governmental stabilization.*—The tendency toward price advance under war stimulus was checked with the advance of 25 cents per barrel in Mid-Continent crude in April, 1918, and definitely controlled in the latter half of 1918 by "The Plan," described on pages 26-29, put into execution by the National Petroleum War Service Committee representing the petroleum industry, and the Oil Division of the United States Fuel Administration representing the Government. Prices were thus stabilized and brought under check on the assumption that further advances would not serve as a

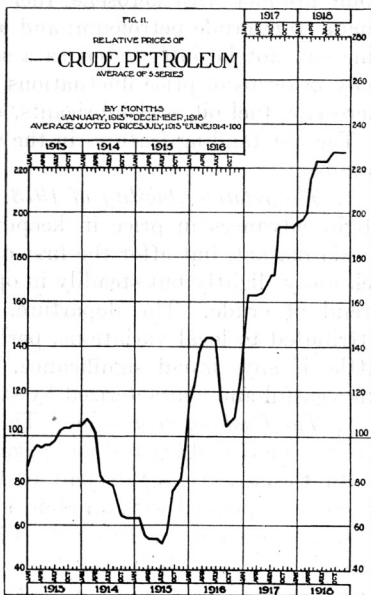


FIG. 11.—Relative price of crude petroleum (weighted average of five leading fields).

sufficient additional stimulus to production to justify the cost to the public.¹

The prices of gasoline.—As representative of the wholesale price of gasoline, the tank-wagon prices² at five populous cities in various parts of the country are assembled—New York, Baltimore, Chicago, Kansas City, and San Francisco being chosen as typical points. The actual fluctuations in these prices are shown in figure 12, while an average of the five reduced to a relative basis is presented in figure 13. It can not be emphasized too strongly that gasoline is a joint product with kerosene, fuel oil, and lubricants, all four being made from crude petroleum, and accordingly that the price of gasoline can not be interpreted as a separate matter, but is intelligible only in terms of price fluctuations in crude, on the one hand, and of kerosene, fuel oil, and lubricants, on the other.³

The outstanding features in the course of gasoline prices are five in number:

1. *The relative stability of 1913.*—Gasoline commenced 1913 with slight advances in price in keeping with the upward trend in the crude market, but after the first quarter of the year, gasoline prices fell away slightly but steadily in opposition to the continued upward trend of crude. The departure, however, was slight and to be attributed to local variations, perhaps fortuitous, and certainly with little, if any, broad significance. This period, on the whole, was uneventful and characterized by stability.

2. *The Cushing depression.*—The gasoline response to the Cushing overproduction described on page 24 was immediate and striking. With the serious impairment of the crude oil market, the price of gasoline responded with an almost parallel slump.⁴

3. *The recovery of 1915-16.*—Closely paralleling the recovery of the crude market following the culmination of the Cushing debacle, and as a result of the same range of causes, gasoline advanced over

¹ As to the correctness of this assumption there is not universal agreement, those adversely affected financially tending to question its validity; but in the light of critical analysis it would appear that the 1917 prices, which averaged far lower than those of 1918, accomplished a far greater rate of production increase than the prices of 1918, leaving the slowing output in 1918 attributable to factors additional to the questionable matter of inadequate price stimulus. In the Mid-Continent field a posted price of \$2.25 a barrel prevailed from April to December, 1918, while during that period the daily average production fell from 363,000 to 297,000 barrels. Production declines in all fields, however, are periodically inevitable, irrespective of price; and the decline in question may be due to physical rather than economic causes.

² That is, the selling price to garages and other bulk purchasers from tank wagons. The public pays, in general, about 2 cents a gallon above the tank-wagon price, this sum covering the expense and profit of the retail station.

³ The interrelationships obtaining between these four products, among themselves and both individually and collectively in respect to crude, is so intricate as almost to defy verbal analysis. A quantitative, graphical presentation of this matter, however, is given in figure 5, and it must be assumed that this chart is held either in view or in mind in connection with the ensuing discussions. A failure to appreciate that the economics of joint production is fundamentally different from the economics of straight production will yield no vantage point for the interpretation of the price fluctuations of petroleum products.

⁴ Gasoline, being the main prop to the cost structure of the petroleum industry, is naturally strongly affected by the varying burden that falls upon the structure. Study of figures 3, 4, and 23 will make this relationship clearer.

Fig 12.

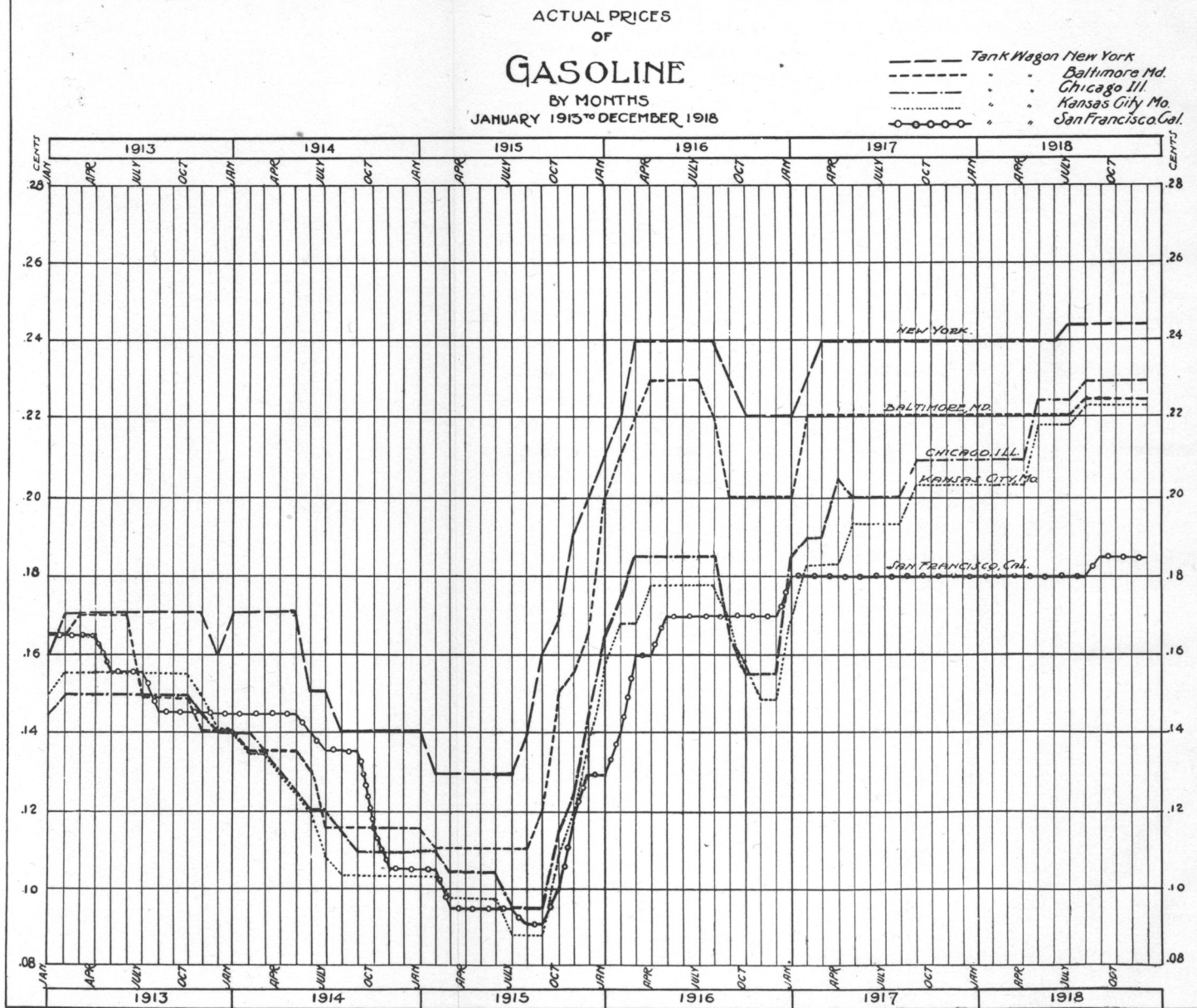


FIG. 12.—Actual market prices of gasoline.

60 per cent between July, 1915, and May, 1916, attaining a price level scarcely less than that prevailing at the end of 1918. The suddenness of the advance in respect to a product in universal use, following so closely upon the heels of an era of cheap gasoline, created country-wide interest and concern and led to an investigation on the part of the Federal Trade Commission,¹ which reported "that a decreasing supply of light crudes, coupled with increasing foreign and domestic demands, explains a part of the advance in gasoline prices during 1915, but that part of the advance in certain sections, at least, was unnecessary and to a certain extent due to artificial conditions. * * *"² But whatever the validity of these conclusions, which must be judged on their own merits, the situation, whether complicated by artificial conditions or not, was the response, or, more properly, the over-response, to the lavishness of the Cushing outpouring of crude.³

4. *The relapse of 1916.*—In the latter half of 1916, gasoline shared in the relapse of crude with a slump felt east of the Rockies. California serenely weathered this storm, whose effects did not reach the Pacific slope.

5. *The period of war stress.*—The relapse of 1916, as with crude, was short lived; gasoline recovered its former price level in early 1917, and to the end of 1918 held a remarkably level course, as compared with the other petroleum products, and

particularly with commodities in general. The Chicago market, during this time, showed a series of advances, reflecting, together with the situation there for kerosene, local instabilities of a significant order.

A uniform price level for gasoline during a period when practically all other commodities were soaring is remarkable and was only attained by virtue of the joint-product character of gasoline, which permitted its potential advances to be covered by kerosene, fuel oil, and lubricants. Advances that might have come about in the last

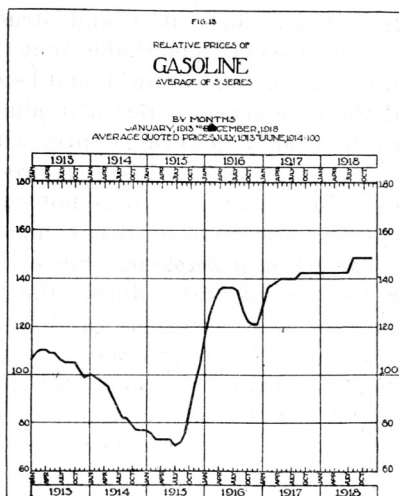


FIG. 13.—Relative price of gasoline. (Average of five leading American markets.)

¹ See Report on the Price of Gasoline in 1915, Federal Trade Commission, Washington, 1917.

² *Ibid.*, p. 16.

³ A study of the curves of "petroleum products" and "all commodities" in fig. 22 is of interest in this connection. Following the governmental investigation of the price of gasoline in 1915, the average price of "petroleum products" sank below the course of "all commodities," where it has remained to the present. Any conclusions to be drawn from this relation, however, must be made with an appreciation of the many factors incident to the situation.

half of 1918 were forestalled by "The Plan" already adverted to, which reflected an indirect influence over gasoline and the other main petroleum products.

On the whole there is a notable coincidence between the price of crude and the price of gasoline. All the main features of the former are reflected in the latter, in modified form. Rarely, and only with local meaning, do the two courses run counter. Again there is a notable coincidence to be followed between gasoline prices in the various cities; the difference corresponding roughly to a transportation differential in respect to the sources of raw material, complicated by the sectional character of the gasoline market as described on page 19. In view of the economic status of petroleum refining, with its wide variations in production costs, the varying strengths of the demands for products turned out along with gasoline, and the geographical disposition and structure of the industrial units concerned, it seems remarkable that there should be such uniformity in price, rather than there should be occasion for surprise at the extent of the divergence.¹ But a product in universal use must normally attain a fairly uniform country-wide level, leaving its joint-products to level off the differences in production costs; and hence from an economic standpoint, it is not surprising that gasoline shows considerable price uniformity as compared with other petroleum products.²

The prices of kerosene.—Since about half of the kerosene produced in the United States during the past six years has been exported, the export price weighs heavily in any consideration of the kerosene situation. The bulk price for export at New York is therefore included in figure 14, along with the domestic prices at five cities—New York, Baltimore, Chicago, Kansas City, and San Francisco. In reading this chart, the curve of export prices should be accorded as much emphasis as the five curves of domestic prices together. Figure 15 shows the curve of relatives for export kerosene contrasted with the average domestic price reduced to a relative basis.

The domestic and export prices of kerosene show a general conformity to each other; but with somewhat more accentuated changes in the case of the export figures. This is to be expected in view of the far-reaching disturbances in foreign trade that prevailed.

Both foreign and domestic prices show responses to the six major events involved in the price of crude, as described on pages 32-33,

¹ The curves, of course, do not show the artificial ununiformities arising from the disintegration of the original Standard Oil Co., as noted on page 19. These differentials, which should be done away with if possible, are sectional, rather than national, and are described in length in a Report on prices and marketing practices covering the distribution of gasoline and kerosene throughout the United States, published by the Fuel Administration.

² About 10 per cent of the domestic gasoline supply is made by blending volatile gasoline recovered from natural gas with petroleum distillates otherwise classifiable as kerosene; but although the production cost of such gasoline is much less than the production cost of refinery gasoline, this circumstance did not affect the selling price of commercial gasoline.

Fig. 14.

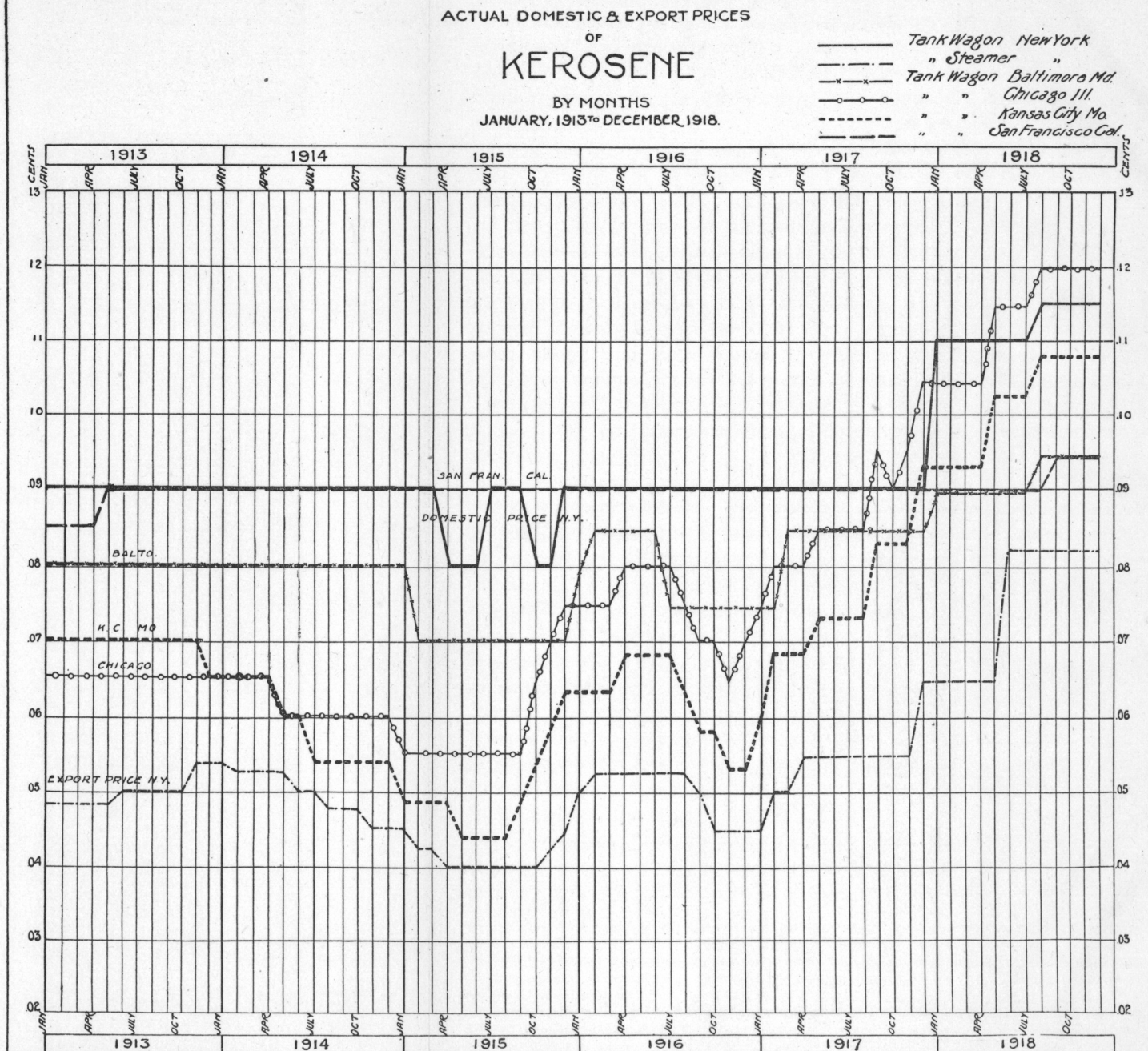


FIG. 14.—Actual domestic and export prices of kerosene.

although the modifications in kerosene prices are more temperate. (Compare figs. 11 and 15.) These influences, inherited from the price status of crude, need not be repeated here. It should be remarked, however, that the effect of the Cushing depression upon kerosene would have been less marked if it had not been coincident with the outbreak of the European war, when disturbances in ocean transportation and foreign markets upset the course of export demand. The two factors of Cushing overproduction and demoralization of foreign markets can scarcely be disentangled and separately weighed; but it should be remembered that, whereas with crude petroleum, gasoline, fuel oil, and lubricants, the Cushing factor was the overpowering depressant, in the case of kerosene the foreign situation may have sounded the dominant note. At any rate, of the main petroleum products, kerosene is normally the least responsive to domestic influences. (See fig. 22.)

In addition to the influences carrying through from the crude petroleum situation, and the complications introduced by virtue of the relative bulk of kerosene exports, two additional factors came strongly into play in 1917-18. These were the coal shortage of the winter of 1917-18, which accentuated the domestic demand for kerosene for heating; and the encroachment of gasoline upon kerosene by reason of the lowering volatility of the former, which permitted the lighter

kerosene fractions to be blended with the gasoline supply.¹ Together these two factors took up so much of the foreign export slack that kerosene weathered the war without price decrease.

In regard to the individual domestic prices, as shown in figure 14, it should be observed that California, as usual, shows an independence of the rest of the country. New York also shows a notable stability and freedom from diverting influences. Chicago, on the other hand, is unusually unstable and in 1917-18 performs some

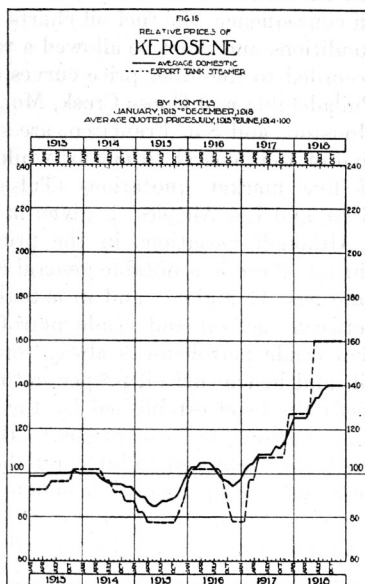


FIG. 15.—Relative prices of kerosene. (Average of five leading American markets and export price, New York.)

¹ The increasing output of highly volatile gasoline made from natural gas encouraged the economic transformation of "kerosene" into "gasoline." It may be added that, irrespective of intent, this circumstance is a normal economic response to the rapidly increasing demand for motor-fuel and bids fair to continue.

strange gyrations, which viewed in connection with the performances of the Chicago market for gasoline, lead to the conclusion that local factors, arising perhaps from marketing conditions, came strongly into evidence. The general advance of one-half cent in July, 1918, was allowed by the Fuel Administration to cover an increase in transportation rates affecting the commodity.

The prices of fuel oil.—The fuel-oil market is complicated by extensive sales on contract, with the result that much of the output changes hands at prices more or less at variance with the current quotations. Also the price records for fuel oil are neither extensive nor sustained for the early years of the period covered in this study. In consequence, the fuel oil charts only approximate the true run of conditions and must be allowed a wider margin of error than is to be accorded to the other price curves of this paper. Realized prices at Philadelphia and Goose Creek, Mo., and market quotations at Tulsa, Houston, and San Francisco, are shown in figure 16, as representative of the general situation; while the relative average fluctuation of five market quotations (Tulsa, Houston, Humble, San Francisco, and Los Angeles) is given in figure 17.

Although variations in the price of fuel oil are numerous and abrupt, there is a notable general conformance, both in trend (compare figs. 11 and 17) and in actual price (compare figs. 10 and 16), between fuel oil and crude petroleum. This arises from the fact that crude petroleum is always open to purchase as a natural fuel oil, and hence fuel oil proper naturally seeks (and can scarcely exceed) the level established by the price of crude.¹ (See fig. 21 for confirmations and exceptions.) By virtue of this price affiliation, the factors adduced to interpret the run of prices in regard to crude petroleum are likewise applicable to fuel oil. Reference may be had, therefore, to pages 31-34, in lieu of a paraphrased account at this point.

In addition to the influences affecting the price of fuel oil, which have already been reviewed under the heading of crude petroleum, there should be mentioned the matter of seasonal variations in demand, with special reference to the fuel shortage of 1917-18. The seasonal factor, involving a stronger demand in winter than in summer, was operative, potentially at least, throughout the six-year period, as may be discerned here and there in figure 16, although the effects of this factor during 1913-1916 were largely hidden beneath stronger reactions resulting from the crude petroleum situation. In the winter of 1917-18, however, the seasonal factor came strongly into play east of the Rocky Mountains, and with an unusually severe winter, a coal shortage, and a transportation tie-up, fuel oil prices in

¹ This holds only in respect to the dominant quantity of fuel oil employed for ordinary fuel uses, such as boiler firing; fuel oil for specialized purposes (which usually involves special qualifications only present in the distilled product) can sustain a price determined by its intrinsic value. With the development of the heavy-oil motor, the price of fuel oil may be expected to attain an independence not now enjoyed.

Fig 16

ACTUAL REALIZED & MARKET PRICES
OF
FUEL OIL
BY MONTHS
JANUARY 1913 TO DECEMBER 1918.



FIG. 16.—Actual realized and market prices of fuel oil.

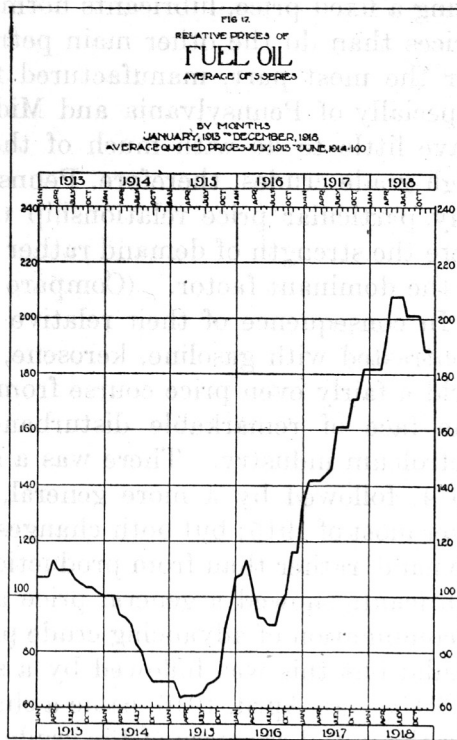
the industrial regions of the Northeastern States in particular rose to unprecedented levels.¹ In consequence of a general policy toward substituting fuel oil for coal in growing degree, the demand for fuel oil became so insistent that the gasoline demand, which had heretofore set the pace, was forced into second place, and the call for fuel oil, with direct reference to munitions manufacture and naval operations, became the dominant note. It was by virtue of these conditions more than any others that gasoline was so largely freed from the responsibility of supporting the advances in the price of crude.

Toward the summer of 1918, while industrial operations were still increasing apace, the demand for fuel oil became tempered by the seasonal factor, while in August the plan of stabilization previously noted came into play with due effect. Together these factors halted the advance, which turned into a decided decline when November announced the termination of European hostilities and threw the United States into a hesitant industrial mood. Thus the cycle was completed, and the motor-fuel demand re-assumed its rôle of prime stimulator of the petroleum industry.²

The prices of lubricating oils.—Lubricating oils are highly fabricated commodities, with a wide range of grades as

compared with gasoline, kerosene, and fuel oil. A characteristic average of lubricant prices is difficult to determine, as there is no central record correlating quantities of output with prices.

Since most of the lubricants produced are manufactured east of the Mississippi, notably in the Northeastern States, prices at New York City are shown as representative of the country, and five impor-



tant lubricants are selected as reflecting with some measure of accuracy the entire situation. To free the view as far as possible from extraneous factors, such as the cost of containers, the prices quoted were selected to represent the basic oils from which the brands coming on the market are compounded. Figure 18 shows the actual price fluctuations at New York of five characteristic oils, while figure 19 gives the average of these fluctuations reduced to a relative basis.

Owing to the specialized character of lubricating oils and to the fact that sales to a considerable extent are based on contracts specifying a fixed price, lubricants normally show a far more even run of prices than do the other main petroleum products. They are also, for the most part, manufactured from high-grade paraffin crudes, especially of Pennsylvania and Mid-Continent origin, and therefore have little to do with much of the crude oil produced. Only the high-grade crudes, therefore, Pennsylvania crude in particular, bear any particular price relationship to the lubricating oils, and even here the strength of demand rather than the cost of the raw material is the dominant factor. (Compare figs. 11 and 19.)

In consequence of their relative independence of crude prices, as contrasted with gasoline, kerosene, and fuel oil, the lubricating oils held a fairly even price course from 1913 through 1914 and 1915, in the face of remarkable disturbances prevailing elsewhere in the petroleum industry. There was a slight advance in some grades in 1914, followed by a more general, though not marked, depression over most of 1915; but both changes reflected conditions arising from demand rather than from production. In the last quarter of 1915, lubricants showed a general price advance, resulting probably from a combination of advancing crude prices with improvement in export trade; but this was followed by a slight decline in the first quarter of 1916. In April, 1916, came a sharp increase in price level, following the initial recovery of the crude market from the Cushing depression and complicated by the growing number of orders for future deliveries.

For the remainder of 1916 and practically all of 1917, lubricants remained stable, showing none of the fluctuations elsewhere taking place. December, 1917, however, saw an abrupt ascent to prices well above those of 1916-17, with further advances in early 1918 to twice the prewar level, to be explained by a combination of circumstances—advances in the price of high-grade crude, general domestic conditions of stress and high costs, transportation congestions, shortages in special grades, and the ever-increasing weight of growing demands. From then to the middle of 1918, the level was maintained, with slight increases in July, followed by a slight average decline in the last half of the year. On the whole, the advances of 1918 over 1917 were striking and much greater than in the case of the

Fig18

ACTUAL PRICES OF LUBRICATING OILS

NEW YORK
BY MONTHS
JANUARY 1913 TO DECEMBER 1918

— Paraffine 903 Specific Gravity
—○— Spindle No 150
- - - Red Paraffine
- - - Spindle No 200
..... Dark Steam Refined

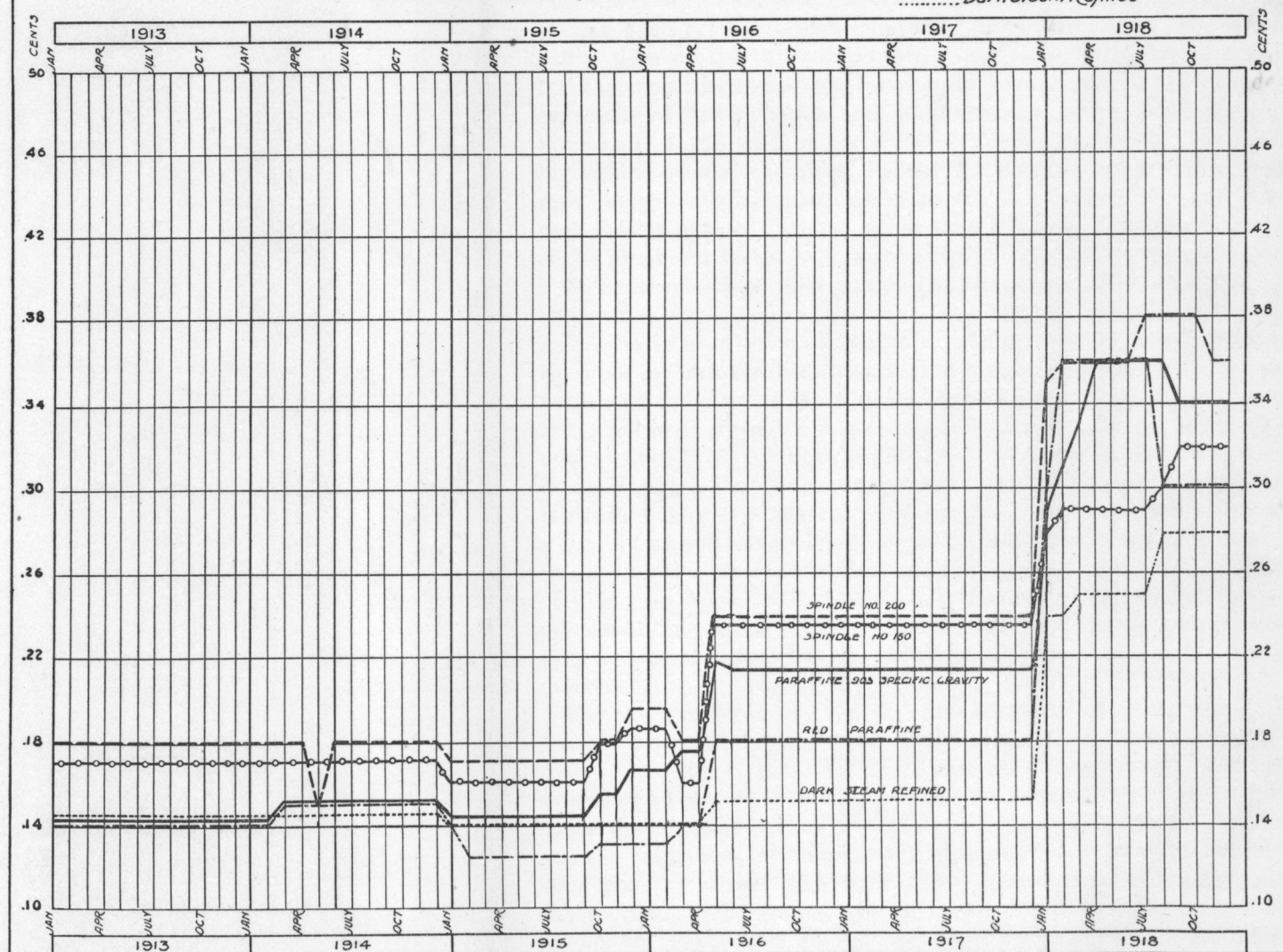


FIG. 18.—Actual market prices of lubricating oils at New York City.

other products of high-grade crude,¹ indicating a greater sympathy with commodities in general than with the fuel members of the petroleum group.

By-products.—Although the petroleum industry turns out a large number of by-products in connection with its four main products—gasoline, kerosene, fuel oil, and lubricants—the by-products are still, on the whole, rather incidental and do not yet exert a marked influence upon the economics of the industry.² (See figs. 3 and 4.) In consequence, the price study is extended to include only two of the two hundred-odd by-products—namely, paraffin wax and petrolatum—in the belief that these will typify the by-product price situ-

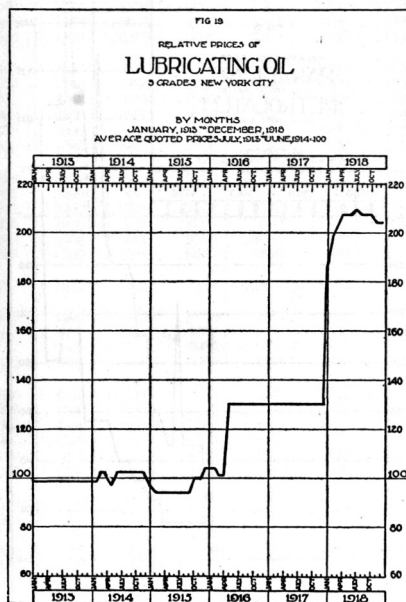


FIG. 19.—Relative price of lubricating oils. (Average of five grades at New York City.)

ation without throwing the main features of the petroleum industry out of perspective with an undue mass of detail at this point.

The relative advances of these two products are shown in figure 20, while the actual quotations may be found in Table 3. The chart shows a rough coincidence with the course of crude prices on the part of paraffin wax, although in 1916, 1917, and 1918 the advances were out of all proportion to those characteristic of the products previously reviewed. It is evident that paraffin wax came in for a strong war

¹ Pennsylvania crude in 1918 attained a height of 165 per cent on the scale of relatives, while the composite of five lubricants advanced to nearly 210 per cent.

² This does not mean to say that petroleum by-products are unimportant; on the contrary, they present unlimited possibilities of development, but their potentialities have been neglected.

demand, which sent its price soaring without respect to production costs.¹ Petrolatum, on the other hand, a product turned out in less bulk than wax, showed no response to the normal factors affecting the petroleum industry; but, under the influence of rising prices during the war, advanced significantly in 1916, 1917, and 1918, with a very sharp rise in late 1918.

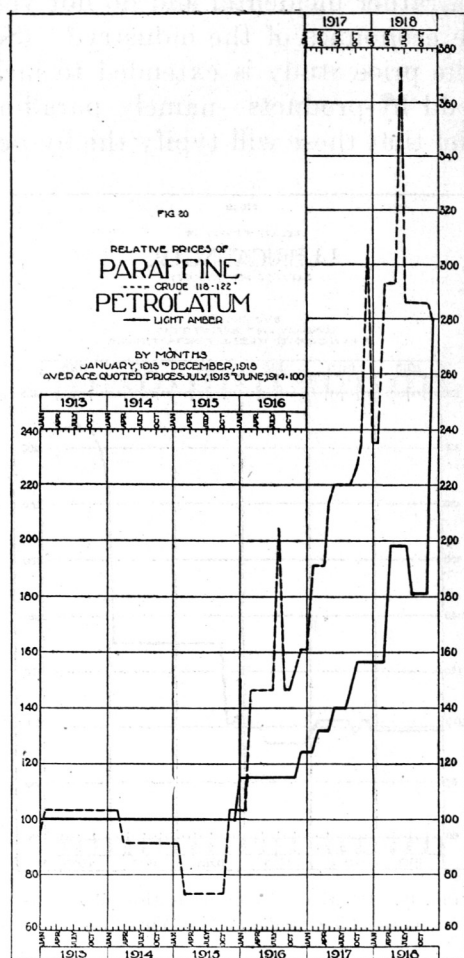


FIG. 20.—Relative prices of petroleum by-products—petrolatum and paraffin.

On the whole, petroleum by-products behaved like the general run of commodities, and coming under no surveillance or control, their prices adjusted themselves readily to the strength of the demand bearing down upon them.

¹ The price advances were largely due to the use of paraffin in the production of munitions; every shell produced was covered either with wax or grease as a protection against moisture.

TABLE 1.—WHOLESALE PRICES OF CRUDE PETROLEUM AND GASOLINE.

	Crude petroleum.					Gasoline.				
	Penn-syl-vania. ¹	Illi-nois. ²	Mid-conti-nent. ³	Gulf. ³	Cali-fornia. ²	Tank wagon.	Tank wagon.	Tank wagon.	Tank wagon.	Tank wagon.
Market.....	At wells.	At wells.	At wells.	At wells.	At wells.	New York. ⁴	Balti-more. ⁵	Chi-cago. ⁵	Kan-sas City. ⁵	San Fran-cisco. ⁵
Unit.....	Barrel (42 galls.).	Barrel (42 galls.).	Barrel (42 galls.).	Barrel (42 galls.).	Barrel (42 galls.).	Gallon.	Gallon.	Gallon.	Gallon.	Gallon.
Base price.....	\$2.4008	\$1.3500	\$0.9725	\$0.7883	\$0.3708	\$0.1975	\$0.1408	\$0.1396	\$0.1413	\$0.1454
1913—Year.....	2.4500	1.2700	.9392	.9000	.3500	.1683	.1575	.1483	.1529	.1542
Quarters—										
First.....	2.3000	1.1467	.8633	.9000	.3500	.1667	.1667	.1483	.1533	.1650
Second.....	2.5000	1.2833	.8800	.9000	.3500	.1700	.1700	.1500	.1550	.1583
Third.....	2.5000	1.3000	.9833	.9000	.3500	.1700	.1500	.1500	.1550	.1483
Fourth.....	2.5000	1.3500	1.0300	.9000	.3500	.1667	.1433	.1450	.1483	.1450
Months—										
January.....	2.0000	1.0800	.8300	.8750	.3500	.1600	.1650	.1450	.1550	.1650
February.....	2.4000	1.1100	.8800	.8750	.3500	.1700	.1650	.1500	.1550	.1650
March.....	2.5000	1.2500	.8800	.9500	.3500	.1700	.1700	.1500	.1550	.1650
April.....	2.5000	1.2500	.8800	.9000	.3500	.1700	.1700	.1500	.1550	.1650
May.....	2.5000	1.3000	.8800	.9000	.3500	.1700	.1700	.1500	.1550	.1550
June.....	2.5000	1.3000	.8800	.9000	.3500	.1700	.1700	.1500	.1550	.1550
July.....	2.5000	1.3000	.9200	.9000	.3500	.1700	.1500	.1500	.1550	.1550
August.....	2.5000	1.3000	1.0000	.9000	.3500	.1700	.1500	.1500	.1550	.1450
September.....	2.5000	1.3000	1.0300	.9000	.3500	.1700	.1500	.1500	.1550	.1450
October.....	2.5000	1.3000	1.0300	.9000	.3500	.1700	.1500	.1500	.1550	.1450
November.....	2.5000	1.3000	1.0300	.9000	.3500	.1700	.1400	.1450	.1500	.1450
December.....	2.5000	1.4500	1.0300	.9000	.3500	.1600	.1400	.1400	.1400	.1450
1914—Year.....	1.9167	1.1842	.7858	.5383	.3917	.1542	.1250	.1221	.1173	.1329
Quarters—										
First.....	2.5000	1.4500	1.0433	.8750	.3833	.1700	.1367	.1383	.1367	.1450
Second.....	2.1033	1.3000	.8333	.4783	.4000	.1633	.1333	.1250	.1250	.1433
Third.....	1.6167	1.0867	.7167	.4000	.4000	.1433	.1150	.1150	.1047	.1350
Fourth.....	1.4500	.9000	.5500	.4000	.3833	.1400	.1150	.1100	.1030	.1083
Months—										
January.....	2.5000	1.4500	1.0300	.9250	.3500	.1700	.1400	.1400	.1400	.1450
February.....	2.5000	1.4500	1.0500	.9250	.4000	.1700	.1350	.1400	.1350	.1450
March.....	2.5000	1.4500	1.0500	.7750	.4000	.1700	.1350	.1350	.1350	.1450
April.....	2.5000	1.4500	1.0000	.5100	.4000	.1700	.1350	.1300	.1300	.1450
May.....	2.0100	1.3000	.7500	.4750	.4000	.1700	.1350	.1250	.1250	.1450
June.....	1.8000	1.1500	.7500	.4500	.4000	.1500	.1300	.1200	.1200	.1400
July.....	1.7500	1.1200	.7500	.4000	.4000	.1500	.1150	.1200	.1080	.1350
August.....	1.6500	1.1200	.7500	.4000	.4000	.1400	.1150	.1150	.1030	.1350
September.....	1.4500	1.0200	.6500	.4000	.4000	.1400	.1150	.1100	.1030	.1350
October.....	1.4500	.9200	.5500	.4000	.4000	.1400	.1150	.1100	.1030	.1150
November.....	1.4500	.8900	.5500	.4000	.3750	.1400	.1150	.1100	.1030	.1050
December.....	1.4500	.8900	.5500	.4000	.3750	.1400	.1150	.1100	.1030	.1050
1915—Year.....	1.5292	.9683	.5792	.4592	.3563	.1483	.1229	.1092	.1022	.1013
Quarters—										
First.....	1.4833	.8733	.5000	.4217	.3750	.1333	.1117	.1083	.1013	.1017
Second.....	1.3667	.8400	.4000	.4250	.3750	.1300	.1100	.1050	.0980	.0950
Third.....	1.4333	.9067	.5500	.4783	.3250	.1433	.1133	.0950	.0880	.0917
Fourth.....	1.8333	1.2533	.8667	.5117	.3500	.1867	.1567	.1283	.1213	.1167
Months—										
January.....	1.4500	.8900	.5500	.4150	.3750	.1400	.1150	.1100	.1030	.1050
February.....	1.5000	.8900	.5500	.4250	.3750	.1300	.1100	.1100	.1030	.1050
March.....	1.5000	.8400	.4000	.4250	.3750	.1300	.1100	.1050	.0980	.0950
April.....	1.4000	.8400	.4000	.4250	.3750	.1300	.1100	.1050	.0980	.0950
May.....	1.3500	.8400	.4000	.4250	.3750	.1300	.1100	.1050	.0980	.0950
June.....	1.3500	.8400	.4000	.4250	.3750	.1300	.1100	.1050	.0980	.0950
July.....	1.3500	.8400	.4000	.4350	.3250	.1300	.1100	.0950	.0880	.0950
August.....	1.3500	.8400	.5000	.5000	.3250	.1400	.1100	.0950	.0880	.0900
September.....	1.6000	1.0400	.7500	.5000	.3250	.1600	.1200	.0950	.0880	.0900
October.....	1.7000	1.1200	.8000	.5000	.3250	.1700	.1500	.1150	.1080	.1000
November.....	1.8000	1.2700	.8000	.5000	.3250	.1900	.1550	.1250	.1180	.1200
December.....	2.0000	1.3700	1.0000	.5350	.4000	.2000	.1650	.1450	.1380	.1300

¹ From Journal of Commerce, New York.² From Oil Trade Journal, New York.³ From Mineral Resources, U. S. Geological Survey.⁴ From Oil, Paint, and Drug Reporter, New York.⁵ From files of National Petroleum War Service Committee, New York.

TABLE 1.—WHOLESALE PRICES OF CRUDE PETROLEUM AND GASOLINE—Continued.

	Crude petroleum.					Gasoline.				
	Penn- sylvania. ¹	Illi- nois. ²	Mid- cont- inent. ³	Gulf. ³	Cal- ifornia. ²	Tank wagon.	Tank wagon.	Tank wagon.	Tank wagon.	Tank wagon.
Market.....	At wells.	At wells.	At wells.	At wells.	At wells.	New York. ⁴	Balti- more. ⁵	Chi- cago. ⁵	Kan- sas City. ⁵	San Fran- cisco. ⁵
Unit.....	Barrel (42 galls.).	Barrel (42 galls.).	Barrel (42 galls.).	Barrel (42 galls.).	Barrel (42 galls.).	Gallon.	Gallon.	Gallon.	Gallon.	Gallon.
Base price.....	\$2.4008	\$1.3500	\$0.9725	\$0.7883	\$0.3708	\$0.1675	\$0.1408	\$0.1396	\$0.1413	\$0.1454
1916—Year.....	2.4833	1.6450	1.2567	.7375	.6092	.2300	.2142	.1733	.1672	.1625
Quarters—										
First.....	2.3333	1.6033	1.3367	.7883	.4733	.2233	.2100	.1750	.1647	.1433
Second.....	2.0000	1.8200	1.5500	.8000	.5933	.2100	.2300	.1850	.1780	.1667
Third.....	2.4667	1.6700	1.1533	.6717	.6433	.2367	.2167	.1783	.1747	.1700
Fourth.....	2.5333	1.4867	.9867	.6900	.7267	.2200	.2000	.1550	.1513	.1700
Months—										
January.....	2.2500	1.4700	1.2300	.7650	.4000	.2100	.2000	.1650	.1580	.1300
February.....	2.3500	1.6200	1.3000	.8000	.4600	.2200	.2100	.1750	.1680	.1400
March.....	2.4000	1.7200	1.4800	.8000	.5000	.2400	.2200	.1850	.1680	.1000
April.....	2.6000	1.8200	1.5500	.8000	.5000	.2400	.2300	.1850	.1780	.1600
May.....	2.0000	1.8200	1.5500	.8000	.6100	.2400	.2300	.1850	.1780	.1700
June.....	2.0000	1.8200	1.5500	.8000	.6100	.2400	.2300	.1850	.1780	.1700
July.....	2.0000	1.8200	1.5200	.7150	.6100	.2400	.2300	.1850	.1780	.1700
August.....	2.5000	1.7200	1.0000	.6500	.6000	.2400	.2200	.1850	.1780	.1700
September.....	2.3000	1.4700	.9000	.6500	.6000	.2300	.2000	.1650	.1680	.1700
October.....	2.4000	1.4700	.9000	.6500	.7100	.2200	.2000	.1550	.1580	.1700
November.....	2.0000	1.4700	.9100	.6500	.7100	.2200	.2000	.1550	.1480	.1700
December.....	2.0000	1.5200	1.1500	.7700	.7000	.2200	.2000	.1550	.1480	.1700
1917—Year.....	3.2000	1.9450	1.7750	.9917	.8975	.2375	.2183	.2008	.1918	.1800
Quarters—										
First.....	2.9833	1.7700	1.0000	.9667	.7000	.2300	.2133	.1883	.1780	.1800
Second.....	3.0833	1.9033	1.7000	1.0000	.8100	.2100	.2200	.2017	.1897	.1800
Third.....	3.2333	1.7867	1.8000	1.0000	1.0100	.2400	.2200	.2033	.1963	.1800
Fourth.....	3.5000	2.1200	2.0000	1.0000	1.0100	.2400	.2200	.2100	.2030	.1800
Months—										
January.....	2.8500	1.6200	1.4000	.9000	.7600	.2200	.2000	.1850	.1680	.1800
February.....	3.0500	1.8200	1.7000	1.0000	.7600	.2300	.2200	.1900	.1830	.1800
March.....	3.0500	1.8700	1.7000	1.0000	.7600	.2400	.2200	.1900	.1830	.1800
April.....	3.0500	1.8700	1.7000	1.0000	.7600	.2400	.2200	.2050	.1830	.1800
May.....	3.1000	1.9200	1.7000	1.0000	.7600	.2400	.2200	.2000	.1930	.1800
June.....	3.1000	1.9200	1.7000	1.0000	.9100	.2400	.2200	.2000	.1930	.1800
July.....	3.1000	1.9200	1.7000	1.0000	1.0100	.2400	.2200	.2000	.1930	.1800
August.....	3.1000	1.9200	1.7000	1.0000	1.0100	.2400	.2200	.2000	.1930	.1800
September.....	3.5000	2.1200	2.0000	1.0000	1.0100	.2400	.2200	.2100	.2030	.1800
October.....	3.5000	2.1200	2.0000	1.0000	1.0100	.2400	.2200	.2100	.2030	.1800
November.....	3.5000	2.1200	2.0000	1.0000	1.0100	.2400	.2200	.2100	.2030	.1800
December.....	3.5000	2.1200	2.0000	1.0000	1.0100	.2400	.2200	.2100	.2030	.1800
1918—Year.....	3.9740	2.3200	2.1875	1.4417	1.1767	.2422	.2221	.2221	.2151	.1817
Quarters—										
First.....	3.8846	2.1533	2.0000	1.1167	1.0100	.2400	.2200	.2100	.2030	.1800
Second.....	4.0000	2.3200	2.2500	1.3500	1.1767	.2400	.2200	.2200	.2130	.1800
Third.....	4.0000	2.3867	2.2500	1.5000	1.2000	.2436	.2233	.2283	.2213	.1817
Fourth.....	4.0000	2.4200	2.2500	1.8000	1.2000	.2450	.2250	.2300	.2230	.1850
Months—										
January.....	3.7500	2.1200	2.0000	1.0000	1.0100	.2400	.2200	.2100	.2030	.1800
February.....	3.9375	2.1200	2.0000	1.0000	1.0100	.2400	.2200	.2100	.2030	.1800
March.....	4.0000	2.2200	2.0000	1.3500	1.0100	.2400	.2200	.2100	.2030	.1800
April.....	4.0000	2.3200	2.2500	1.3500	1.0100	.2400	.2200	.2100	.2030	.1800
May.....	4.0000	2.3200	2.2500	1.3500	1.2000	.2400	.2200	.2250	.2180	.1800
June.....	4.0000	2.3200	2.2500	1.3500	1.2000	.2400	.2200	.2250	.2180	.1800
July.....	4.0000	2.3200	2.2500	1.3500	1.2600	.2410	.2200	.2250	.2180	.1800
August.....	4.0000	2.4200	2.2500	1.3500	1.2600	.2450	.2250	.2300	.2230	.1800
September.....	4.0000	2.4200	2.2500	1.8000	1.2600	.2450	.2250	.2300	.2230	.1850
October.....	4.0000	2.4200	2.2500	1.8000	1.2000	.2450	.2250	.2300	.2230	.1850
November.....	4.0000	2.4200	2.2500	1.8000	1.2000	.2450	.2250	.2300	.2230	.1850
December.....	4.0000	2.4200	2.2500	1.8000	1.2000	.2450	.2250	.2300	.2230	.1850

¹ From Journal of Commerce, New York.² From Oil Trade Journal, New York.³ From Mineral Resources, U. S. Geological Survey.⁴ From Oil, Paint, and Drug Reporter, New York.⁵ From files of National Petroleum War Service Committee, New York.

TABLE 2.—WHOLESALE PRICES OF KEROSENE AND LUBRICATING OIL.

	Stand- ard white 110° test for export.	Kerosene (illuminating oil).					Lubricating oil. ¹				
		Tank wa- gon.	Tank wa- gon.	Tank wa- gon.	Tank wa- gon.	Tank wa- gon.	Para- ffin 903° sp. gr.	Red para- ffin.	Dark steam re- fined.	Spin- dle No. 200.	Spin- dle No. 150.
Market.....	New York. ¹	New York. ¹	Balti- more. ²	Chica- go. ²	Kan- sas City. ²	San Fran- cisco. ²	New York.	New York.	New York.	New York.	New York.
Unit.....	Gall.	Gall.	Gall.	Gall.	Gall.	Gall.	Gall.	Gall.	Gall.	Gall.	Gall.
Base price.....	\$0.051	\$0.090	\$0.080	\$0.064	\$0.066	\$0.090	\$0.146	\$0.143	\$0.145	\$0.178	\$0.170
1913—Year .....	.050	.090	.080	.065	.070	.088	.143	.140	.145	.180	.170
Quarters—											
First.....	.048	.090	.080	.065	.070	.085	.143	.140	.145	.180	.170
Second.....	.049	.090	.080	.065	.070	.088	.143	.140	.145	.180	.170
Third.....	.050	.090	.080	.065	.070	.090	.143	.140	.145	.180	.170
Fourth.....	.052	.090	.080	.065	.068	.090	.143	.140	.145	.180	.170
Months—											
January.....	.048	.090	.080	.065	.070	.085	.143	.140	.145	.180	.170
February.....	.048	.090	.080	.065	.070	.085	.143	.140	.145	.180	.170
March.....	.048	.090	.080	.065	.070	.085	.143	.140	.145	.180	.170
April.....	.048	.090	.080	.065	.070	.086	.143	.140	.145	.180	.170
May.....	.048	.090	.080	.065	.070	.090	.143	.140	.145	.180	.170
June.....	.050	.090	.080	.065	.070	.090	.143	.140	.145	.180	.170
July.....	.050	.090	.080	.065	.070	.090	.143	.140	.145	.180	.170
August.....	.050	.090	.080	.065	.070	.090	.143	.140	.145	.180	.170
September.....	.050	.090	.080	.065	.070	.090	.143	.140	.145	.180	.170
October.....	.050	.090	.080	.065	.070	.090	.143	.140	.145	.180	.170
November.....	.053	.090	.080	.065	.070	.090	.143	.140	.145	.180	.170
December.....	.053	.090	.080	.065	.065	.090	.143	.145	.145	.180	.170
1914—Year .....	.050	.090	.080	.062	.058	.090	.151	.148	.145	.178	.170
Quarters—											
First.....	.053	.090	.080	.065	.065	.090	.146	.143	.145	.180	.170
Second.....	.052	.090	.080	.062	.062	.090	.153	.150	.145	.170	.170
Third.....	.048	.090	.080	.060	.053	.090	.153	.150	.145	.180	.170
Fourth.....	.046	.090	.080	.060	.053	.090	.153	.150	.145	.180	.170
Months—											
January.....	.053	.090	.080	.065	.065	.090	.143	.140	.145	.180	.170
February.....	.053	.090	.080	.065	.065	.090	.143	.140	.145	.180	.170
March.....	.053	.090	.080	.065	.065	.090	.153	.150	.145	.150	.170
April.....	.053	.090	.080	.065	.065	.090	.153	.150	.145	.180	.170
May.....	.053	.090	.080	.060	.060	.090	.153	.150	.145	.180	.170
June.....	.050	.090	.080	.060	.060	.090	.153	.150	.145	.180	.170
July.....	.050	.090	.080	.060	.053	.090	.153	.150	.145	.180	.170
August.....	.048	.090	.060	.060	.053	.090	.153	.150	.145	.180	.170
September.....	.048	.090	.080	.060	.053	.090	.153	.150	.145	.180	.170
October.....	.048	.090	.080	.060	.053	.090	.153	.150	.145	.180	.170
November.....	.045	.090	.080	.060	.053	.090	.153	.150	.145	.180	.170
December.....	.045	.090	.080	.060	.053	.090	.153	.150	.145	.180	.170
1915—Year .....	.041	.086	.071	.059	.049	.090	.147	.128	.140	.174	.165
Quarters—											
First.....	.043	.090	.073	.055	.048	.090	.143	.130	.140	.170	.160
Second.....	.040	.080	.070	.055	.045	.090	.143	.125	.140	.170	.160
Third.....	.040	.090	.070	.055	.045	.090	.143	.125	.140	.170	.160
Fourth.....	.043	.083	.070	.070	.058	.090	.159	.130	.140	.185	.182
Months—											
January.....	.045	.090	.080	.055	.048	.090	.143	.140	.140	.170	.160
February.....	.043	.090	.070	.055	.048	.090	.143	.125	.140	.170	.160
March.....	.043	.090	.070	.055	.048	.090	.143	.125	.140	.170	.160
April.....	.040	.080	.070	.055	.048	.090	.143	.125	.140	.170	.160
May.....	.040	.080	.070	.055	.043	.090	.143	.125	.140	.170	.160
June.....	.040	.080	.070	.055	.043	.090	.143	.125	.140	.170	.160
July.....	.040	.090	.070	.055	.043	.090	.143	.125	.140	.170	.160
August.....	.040	.090	.070	.055	.043	.090	.143	.125	.140	.170	.160
September.....	.040	.090	.070	.055	.048	.090	.143	.125	.140	.170	.160
October.....	.040	.080	.070	.065	.053	.090	.155	.130	.140	.180	.180
November.....	.043	.080	.070	.070	.058	.090	.155	.130	.140	.180	.180
December.....	.045	.090	.070	.075	.063	.090	.168	.130	.140	.195	.185

¹ From Oil, Paint, and Drug Reporter, New York.² From files of National Petroleum War Service Committee, New York.

TABLE 2.—WHOLESALE PRICES OF KEROSENE AND LUBRICATING OIL—Continued.

	Standard white 110° test for export.	Kerosene (illuminating oil).					Lubricating oil. ¹				
		Tank wa-gon.	Tank wa-gon.	Tank wa-gon.	Tank wa-gon.	Tank wa-gon.	Para-fin 903° sp. gr.	Red para-fin.	Dark steam re-fined.	Spin-dle No. 200.	Spin-dle No. 150.
Market.....	New York. ¹	New York. ¹	Balti-more. ²	Chica-go. ²	Kan-sas City. ²	San Fran-cisco. ²	New York.	New York.	New York.	New York.	New York.
Unit.....	Gall.	Gall.	Gall.	Gall.	Gall.	Gall.	Gall.	Gall.	Gall.	Gall.	Gall.
Base price.....	\$0.051	\$0.090	\$0.080	\$0.064	\$0.086	\$0.090	\$0.146	\$0.143	\$0.145	\$0.178	\$0.170
1916—Year.....	.050	.090	.080	.075	.062	.090	.201	.165	.147	.223	.214
Quarters—											
First.....	.052	.090	.083	.075	.063	.090	.170	.133	.140	.190	.177
Second.....	.053	.090	.085	.080	.068	.090	.203	.167	.147	.220	.210
Third.....	.052	.090	.075	.075	.063	.090	.215	.180	.150	.240	.235
Fourth.....	.045	.090	.075	.068	.055	.090	.215	.180	.150	.240	.235
Months—											
January.....	.050	.090	.080	.075	.063	.090	.168	.130	.140	.195	.185
February.....	.053	.090	.085	.075	.063	.090	.168	.130	.140	.195	.185
March.....	.053	.090	.085	.075	.063	.090	.175	.140	.140	.180	.160
April.....	.053	.090	.085	.080	.068	.090	.175	.140	.140	.180	.160
May.....	.053	.090	.085	.080	.068	.090	.218	.180	.150	.240	.235
June.....	.053	.090	.085	.080	.068	.090	.215	.180	.150	.240	.235
July.....	.053	.090	.075	.080	.068	.090	.215	.180	.150	.240	.235
August.....	.053	.090	.075	.075	.063	.090	.215	.180	.150	.240	.235
September.....	.050	.090	.075	.070	.058	.090	.215	.180	.150	.240	.235
October.....	.045	.090	.075	.070	.058	.090	.215	.180	.150	.240	.235
November.....	.045	.090	.075	.065	.053	.090	.215	.180	.150	.240	.235
December.....	.045	.090	.075	.070	.053	.090	.215	.180	.150	.240	.235
1917—Year.....	.054	.090	.083	.087	.075	.090	.215	.180	.150	.240	.235
Quarters—											
First.....	.048	.090	.078	.078	.065	.090	.215	.180	.150	.240	.235
Second.....	.055	.090	.085	.083	.071	.090	.215	.180	.150	.240	.235
Third.....	.055	.090	.085	.088	.076	.090	.215	.180	.150	.240	.235
Fourth.....	.058	.090	.085	.097	.086	.090	.215	.180	.150	.240	.235
Months—											
January.....	.045	.090	.075	.075	.058	.090	.215	.180	.150	.240	.235
February.....	.050	.090	.075	.080	.068	.090	.215	.180	.150	.240	.235
March.....	.050	.090	.085	.080	.068	.090	.215	.180	.150	.240	.235
April.....	.055	.090	.085	.080	.068	.090	.215	.180	.150	.240	.235
May.....	.055	.090	.085	.085	.073	.090	.215	.180	.150	.240	.235
June.....	.055	.090	.085	.085	.073	.090	.215	.180	.150	.240	.235
July.....	.055	.090	.085	.085	.073	.090	.215	.180	.150	.240	.235
August.....	.055	.090	.085	.085	.073	.090	.215	.180	.150	.240	.235
September.....	.055	.090	.085	.095	.083	.090	.215	.180	.150	.240	.235
October.....	.055	.090	.085	.090	.083	.090	.215	.180	.150	.240	.235
November.....	.055	.090	.085	.095	.083	.090	.215	.180	.150	.240	.235
December.....	.065	.090	.085	.105	.093	.090	.215	.180	.150	.240	.235
1918—Year.....	.075	.112	.092	.114	.102	.092	.341	.330	.261	.366	.300
Quarters—											
First.....	.065	.110	.090	.105	.093	.090	.310	.337	.243	.357	.287
Second.....	.071	.110	.090	.112	.100	.090	.360	.360	.250	.360	.290
Third.....	.083	.113	.093	.118	.106	.092	.353	.320	.270	.380	.303
Fourth.....	.083	.115	.095	.120	.108	.095	.340	.300	.280	.367	.320
Months—											
January.....	.065	.110	.090	.105	.093	.090	.290	.290	.240	.350	.280
February.....	.065	.110	.090	.105	.093	.090	.310	.360	.240	.360	.290
March.....	.065	.110	.090	.105	.093	.090	.330	.360	.250	.360	.290
April.....	.065	.110	.090	.105	.093	.090	.360	.360	.250	.360	.290
May.....	.065	.110	.090	.115	.103	.090	.360	.360	.250	.360	.290
June.....	.083	.110	.090	.115	.103	.090	.360	.360	.250	.360	.290
July.....	.083	.110	.090	.115	.103	.090	.360	.360	.250	.380	.290
August.....	.083	.115	.095	.120	.108	.090	.360	.300	.280	.380	.300
September.....	.083	.115	.095	.120	.108	.095	.340	.300	.280	.380	.320
October.....	.083	.115	.095	.120	.108	.095	.340	.300	.280	.380	.320
November.....	.083	.115	.095	.120	.108	.095	.340	.300	.280	.360	.320
December.....	.083	.115	.095	.120	.108	.095	.340	.300	.280	.360	.320

¹ From Oil, Paint, and Drug Reporter, New York.² From files of National Petroleum War Service Committee, New York.

TABLE 3.—WHOLESALE PRICES OF FUEL OIL, PARAFFIN, AND PETROLATUM.

	Fuel oil.							Paraf- fin, ² crude, 118°-122°	Petro- latum ² (light amber).
	Wholesale market prices. ¹					Price realized by refinery.			
Market.....	Tulsa, Okla.	Hum- ble, Tex.	Hous- ton, Tex.	San Francis- co.	Los Angeles, Calif.	Phila- delphia.	³ Goose Creek, Mo.	New York.	New York.
Unit.....	Barrel.	Barrel.	Barrel.	Barrel.	Barrel.	Barrel.	Barrel.	Pound.	Pound.
Base price.....	\$0.7979	\$1.1121	\$1.1208	\$0.8042	\$0.7117	\$1.6258	.....	\$0.0341	\$0.0300
1913—Year.....	.9021	1.2100	1.2408	.7667	.7167	1.5432	.....	.0348	.0300
Quarters—									
First.....	1.0750	1.1000	1.1800	.7500	.7500	1.5386	.....	.0342	.0300
Second.....	.9417	1.2750	1.3000	.7500	.7500	1.5680	.....	.0350	.0300
Third.....	.7917	1.2750	1.2833	.7667	.7167	1.5344	.....	.0350	.0300
Fourth.....	.8000	1.1900	1.2000	.8000	.6500	1.5316	\$0.8022	.0350	.0300
Months—									
January.....	1.0750	1.1000	1.1800	.7500	.7500	1.6128	.....	.0325	.0300
February.....	1.0750	1.1000	1.1800	.7500	.7500	1.5120	.....	.0350	.0300
March.....	1.0750	1.1000	1.1800	.7500	.7500	1.4910	.....	.0350	.0300
April.....	1.0750	1.2750	1.3000	.7500	.7500	1.5582	.....	.0350	.0300
May.....	.8750	1.2750	1.3000	.7500	.7500	1.7052	.....	.0350	.0300
June.....	.8750	1.2750	1.3000	.7500	.7500	1.4406	.....	.0350	.0300
July.....	.8750	1.2750	1.3000	² .7500	⁵ .7500	1.4364	.....	.0350	.0300
August.....	.7500	1.2750	1.3000	.7500	.7500	1.7010	.....	.0350	.0300
September.....	.7500	1.2750	1.2500	.8000	.6500	1.4659	.....	.0350	.0300
October.....	.8000	1.1900	1.2250	.8000	.6500	1.4574	.....	.0350	.0300
November.....	.8000	1.1900	1.2250	.8000	.6500	1.6128	.....	.0350	.0300
December.....	.8000	1.1900	1.1500	.8000	.6500	1.5246	.8022	.0350	.0300
1914—Year.....	.6625	.8500	.8542	.7708	.7183	1.5509	.6073	.0322	.0300
Quarters—									
First.....	.8000	1.1500	1.1500	.8000	.6500	1.7710	.7770	.0350	.0300
Second.....	.8000	.8333	.8500	.8500	.8300	1.6660	.7518	.0313	.0300
Third.....	.5750	.7167	.7167	.7833	.7633	1.4686	.5026	.0313	.0300
Fourth.....	.4750	.7000	.7000	.6500	.6300	1.2978	.3976	.0313	.0300
Months—									
January.....	.8000	1.1500	1.1500	.8000	.6500	1.7682	.7938	.0350	.0300
February.....	.8000	1.1500	1.1500	.8000	.6500	1.8354	.7770	.0350	.0300
March.....	.8000	1.1500	1.1500	.8000	.6500	1.7094	.7602	.0350	.0300
April.....	.8000	.8500	.9000	.8500	.8300	1.7220	.7812	.0313	.0300
May.....	.8000	.8500	.8500	.8500	.8300	1.6250	.7476	.0313	.0300
June.....	.8000	.8000	.8000	.8500	.8300	1.6506	.7266	.0313	.0300
July.....	.5750	.7500	.7500	.8500	.8300	1.5162	.6804	.0313	.0300
August.....	.5750	.7000	.7000	.8500	.8300	1.4658	.4200	.0313	.0300
September.....	.5750	.7000	.7000	.6500	.6300	1.4238	.4074	.0313	.0300
October.....	.4750	.7000	.7000	.6500	.6300	1.3692	.4074	.0313	.0300
November.....	.4750	.7000	.7000	.6500	.6300	1.3314	.3990	.0313	.0300
December.....	.4750	.7000	.7000	.6500	.6300	1.1928	.3864	.0313	.0300
1915—Year.....	.5125	.6771	.6927	.6833	.6625	1.1067	.4459	.0277	.0300
Quarters—									
First.....	.4167	.6750	.6750	.6500	.6300	1.0836	.3710	.0292	.0300
Second.....	.3750	.6250	.6250	.6500	.6300	1.0374	.3668	.0250	.0300
Third.....	.4750	.6333	.6792	.6500	.6300	1.0640	.4186	.0250	.0300
Fourth.....	.7833	.7750	.7917	.7833	.7600	1.2418	.6272	.0317	.0300
Months—									
January.....	.4500	.7000	.7000	.6500	.6300	1.1424	.3780	.0313	.0300
February.....	.4500	.7000	.7000	.6500	.6300	1.0710	.3738	.0313	.0300
March.....	.3500	.6250	.6250	.6500	.6300	1.0374	.3612	.0250	.0300
April.....	.3750	.6250	.6250	.6500	.6300	1.0332	.3654	.0250	.0300
May.....	.3750	.6250	.6250	.6500	.6300	1.0374	.3864	.0250	.0300
June.....	.3750	.6250	.6250	.6500	.6300	1.0416	.3486	.0250	.0300
July.....	.3750	.6250	.6875	.6500	.6300	1.0920	.3444	.0250	.0300
August.....	.5250	.6250	.6750	.6500	.6300	1.0374	.3990	.0250	.0300
September.....	.5250	.6500	.6750	.6500	.6300	1.0626	.5124	.0250	.0300
October.....	.6250	.6500	.6750	.6500	.6300	1.2390	.5586	.0250	.0300
November.....	.7750	.8000	.8500	⁵ .8000	⁵ .8000	1.2600	.5880	.0350	.0300
December.....	.9500	.8750	.8500	⁵ .9000	.8500	1.2264	.7350	.0350	.0300

¹ From Oil Trade Journal, New York.² From Oil, Paint, and Drug Reporter, New York.³ From files of Atlantic Refining Co., Pittsburgh.⁴ From files of Cosden & Co., Tulsa.⁵ Interpolated.

TABLE 3.—WHOLESALE PRICES OF FUEL OIL, PARAFFIN, AND PETROLATUM—Contd.

Market.....	Fuel oil.							Paraf- fin, ² crude, 118°-122°	Petro- latum ² (light amber).
	Wholesale market prices. ¹						Price realized by refinery.		
	Tulsa, Okla.	Hum- ble, Tex.	Hous- ton, Tex.	San Francis- co.	Los Angeles, Calif.	Phila- delphia. ³	Goose Creek, Mo. ⁴	New York.	New York.
Unit.....	Barrel.	Barrel.	Barrel.	Barrel.	Barrel.	Barrel.	Barrel.	Pound.	Pound.
Base price.....	\$0.7979	\$1.1121	\$1.1208	\$0.8042	\$0.7117	\$1.6258	.....	\$0.0341	\$0.0300
1916—Year.....	.8708	.9000	.9208	.9771	.9771	1.6034	\$0.9062	.0498	.0352
Quarters—									
First.....	1.0833	1.0167	1.0667	.9000	.9000	1.4952	.9674	.0400	.0350
Second.....	.7667	.8750	.9083	.9083	.9033	1.5148	1.1382	.0500	.0350
Third.....	.6500	.7750	.7750	1.0000	1.0000	1.6842	.8232	.0567	.0350
Fourth.....	.9833	.9333	.9333	1.1000	1.1000	1.7192	.6958	.0525	.0358
Months—									
January.....	1.0250	1.0000	1.0500	.9000	.9000	1.4448	.9534	.0350	.0350
February.....	1.0750	1.0000	1.0500	.9000	.9000	1.5204	.9912	.0350	.0350
March.....	1.1500	1.0500	1.1000	.9000	.9000	1.5204	.9576	.0500	.0350
April.....	.9000	.9750	1.0250	.9000	.9000	1.5238	1.1676	.0500	.0350
May.....	.7000	.8250	.8750	.9000	.9000	1.4448	1.1550	.0500	.0350
June.....	.7000	.8250	.8250	5.9250	5.9250	1.5708	1.0920	.0500	.0350
July.....	.6500	.7750	.7750	.9500	.9500	1.6884	1.0626	.0500	.0350
August.....	.6500	.7750	.7750	.9500	.9500	1.7052	.7728	.0700	.0350
September.....	.6500	.7750	.7750	5.1.1000	5.1.1000	1.6590	.6342	.0500	.0350
October.....	.7000	.8500	.8500	5.1.1000	5.1.1000	1.6632	.6258	.0500	.0350
November.....	1.1250	.9750	.9750	1.1000	1.1000	1.7052	.5712	.0525	.0350
December.....	1.1250	.9750	.9750	1.1000	1.1000	1.7892	.8904	5.0550	.0375
1917—Year.....	1.5250	1.4167	1.4354	1.3346	1.3188	2.3454	1.2271	.0738	.0425
Quarters—									
First.....	1.5000	1.2167	1.2583	1.1667	1.1667	1.8368	1.0318	.0617	.0383
Second.....	1.4583	1.2667	1.3000	1.2717	1.2550	2.0006	1.0850	.0708	.0408
Third.....	1.3750	1.5500	1.5500	1.4500	1.4150	2.6936	1.1844	.0750	.0433
Fourth.....	1.7667	1.6333	1.6333	1.4500	1.4383	2.8504	1.6072	.0875	.0475
Months—									
January.....	1.5000	1.1500	1.1750	1.1000	1.1000	1.8312	1.0206	.0550	.0375
February.....	1.5000	1.2500	1.3000	1.2000	1.2000	1.8018	1.0080	.0650	.0375
March.....	1.5000	1.2500	1.3000	1.2000	1.2000	1.8774	1.0668	.0650	.0400
April.....	1.5000	1.2500	1.3000	1.2000	1.2000	1.8732	.8568	.0650	.0400
May.....	1.5000	1.2500	1.3000	1.2500	1.2500	1.9908	1.1508	.0725	.0400
June.....	1.3750	1.3000	1.3000	1.3650	1.3150	2.1378	1.2474	.0750	.0425
July.....	1.3750	1.5500	1.5500	1.4500	1.4150	2.7090	.8652	.0750	.0425
August.....	1.3750	1.5500	1.5500	1.4500	1.4150	2.6964	1.1928	.0750	.0425
September.....	1.3750	1.5500	1.5500	1.4500	1.4150	2.6754	1.4952	.0750	.0450
October.....	1.8000	1.5500	1.5500	1.4500	1.4150	2.7762	1.6758	.0775	.0475
November.....	1.7500	1.5500	1.5500	1.4500	1.4500	2.8518	1.6464	.0800	.0475
December.....	1.7500	1.8000	1.8000	1.4500	1.4500	2.9232	1.4994	.1050	.0475
1918—Year.....	1.8854	1.9896	1.9021	1.5500	1.5500	3.1861	2.3059	.0975	.0573
Quarters—									
First.....	1.7500	1.8000	1.8000	1.4500	1.4500	3.1696	2.3898	.0867	.0475
Second.....	2.0000	2.0917	2.0250	1.5500	1.5500	3.1738	2.2326	.1092	.0600
Third.....	1.9167	2.1750	1.9750	1.6000	1.6000	3.1934	2.3293	.0975	.0567
Fourth.....	1.8750	1.8917	1.8083	1.6000	1.6000	3.2074	2.2720	.0967	.0650
Months—									
January.....	1.7500	1.8000	1.8000	1.4500	1.4500	3.2004	2.1529	5.0300	.0475
February.....	1.7500	1.8000	1.8000	1.4500	1.4500	3.1500	2.5090	.0300	.0475
March.....	1.7500	1.8000	1.8000	1.4500	1.4500	3.1584	2.5074	.1000	.0475
April.....	2.0000	1.9250	1.9250	1.4500	1.4500	3.2172	2.1319	.1000	.0600
May.....	2.0000	2.1750	2.0750	1.6000	1.6000	3.0912	2.2054	.1000	.0600
June.....	2.0000	2.1750	2.0750	1.6000	1.6000	3.2130	2.3604	.1275	.0600
July.....	2.0000	2.1750	2.0750	1.6000	1.6000	3.2340	2.3486	.0975	.0600
August.....	1.8750	2.1750	1.9250	1.6000	1.6000	3.1164	2.3142	.0975	.0550
September.....	1.8750	2.1750	1.9250	1.6000	1.6000	3.2298	2.3251	.0975	.0550
October.....	1.8750	2.1750	1.9250	1.6000	1.6000	3.2038	2.3192	.0975	.0550
November.....	1.8750	1.7500	1.7500	1.6000	1.6000	3.2550	2.2806	5.0975	.0550
December.....	1.8750	1.7500	1.7500	1.6000	1.6000	3.1584	2.2163	.0950	.0850

¹ From Oil Trade Journal, New York.² From Oil, Paint, and Drug Reporter, New York.³ From files of Atlantic Refining Co., Pittsburgh.⁴ From files of Cosden & Co., Tulsa.⁵ Interpolated.

Fig. 21

AVERAGE ACTUAL PRICES
PER BARREL
OF

PETROLEUM

AND ITS PRODUCTS
1 CRUDE PETROLEUM 2 GASOLINE 3 KEROSENE 4 FUEL OIL
5 LUBRICATING OIL
BY MONTHS

--- Kerosene (Domestic)
--- Crude Petroleum
--- Gasoline
--- Lubricating Oils
--- Kerosene Oil (Export)
--- Fuel Oil

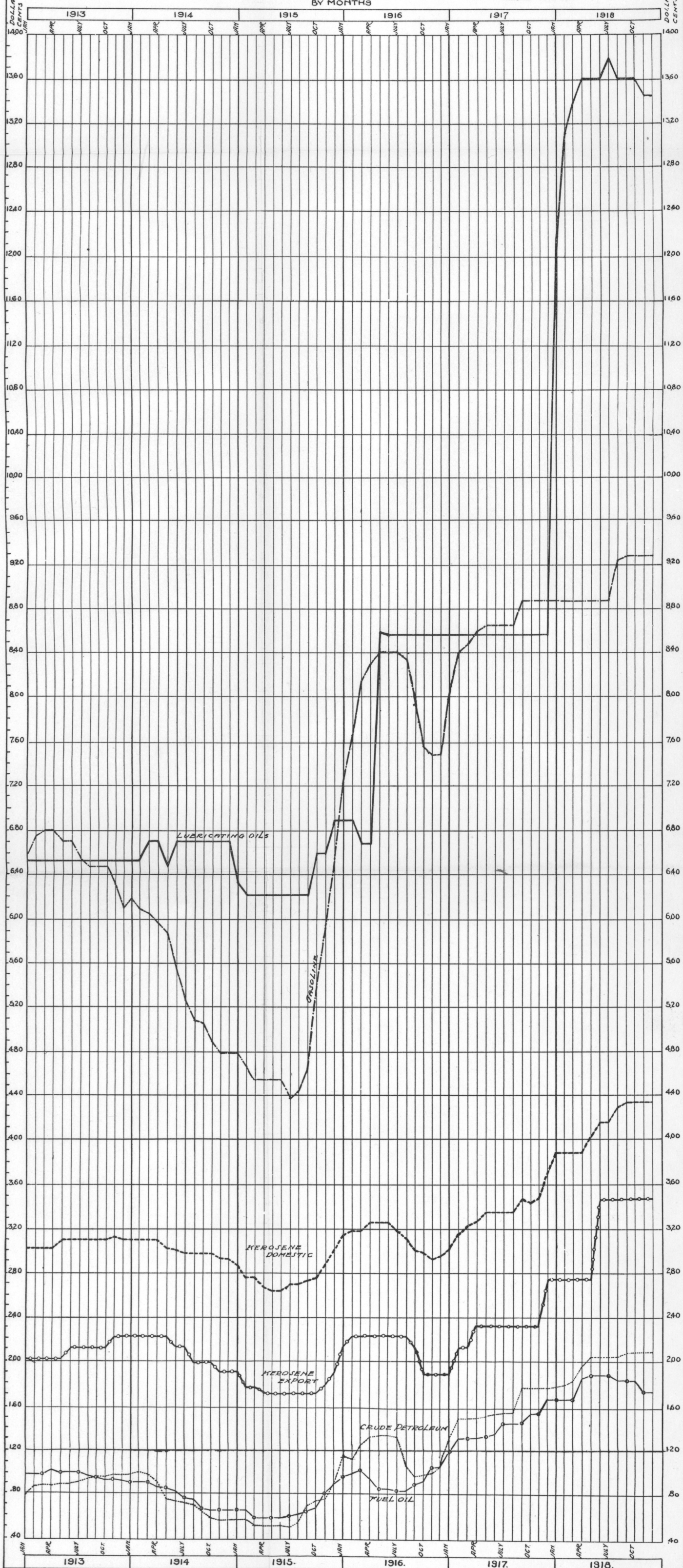


FIG. 21.—Average actual prices of (1) crude petroleum, (2) gasoline, (3) kerosene, (4) fuel oil, and (5) lubricating oil.

SUMMARY.

Summarized comparison of the actual prices of petroleum and its main products.—For the purpose of summarizing the run of actual prices in the petroleum industry, the various actual price quotations given in Tables 1, 2, and 3 have been averaged in respect to crude petroleum and its four main products, and the results charted on the same scale in figure 21. This chart should be read with the precaution of holding clearly in mind (1) the bulk relationships of the petroleum industry (see fig. 3) and (2) the accentuation of the curves of gasoline, kerosene, and lubricating oil, as compared with fuel oil and crude, arising from the uniform charting of all these products on a barrel basis. This word of warning is to prevent the use of curves of summarized actuals for purposes of comparison for which the curves of summarized relatives are better suited. Figure 21, however, will serve to show the average course of fluctuations for the commodities given, together with the general concurrences and discordances in their respective trends. The close conformance of crude and fuel oil is worthy of note again at this place, as well as the comparative stability of gasoline in 1916–1918.

Summarized comparison of the relative prices of petroleum, petroleum products, and commodities in general.—In order to bring the trend of prices in the petroleum industry into a still more summarized view, the relative prices for (1) crude petroleum, (2) petroleum products, and (3) a combination of crude petroleum and petroleum products, have been calculated from the data previously reviewed and the results plotted in figure 22.¹ For comparison, and to serve as a base line from which the oil curves may be broadly interpreted, a curve of relative fluctuations in commodities in general has also been introduced.² In addition to responses to the price factors heretofore described, this composite chart shows further relations of considerable significance, as follows:

1. The price of crude petroleum is more susceptible to variations than the price of petroleum products. Thus the Cushing overproduction depressed the price of crude petroleum below the price of petroleum products; while the reaction to the Cushing depression, in turn, elevated the price of crude above the price of products. The same relationship repeated itself in less accentuated form during the succeeding market slump of 1916.

2. The price of crude petroleum rose rather markedly above the price of "all commodities" on the rebound from the Cushing depres-

¹ The curves on this chart represent weighted averages, or "index numbers," and are prepared in conformance with the index numbers appearing in the other bulletins of the series, *History of Prices During the War*, published by the War Industries Board.

² The data for "all commodities" are from index numbers worked out by Price Section, Bureau of Planning and Statistics, War Industries Board. (See special bulletin on the subject in press.)

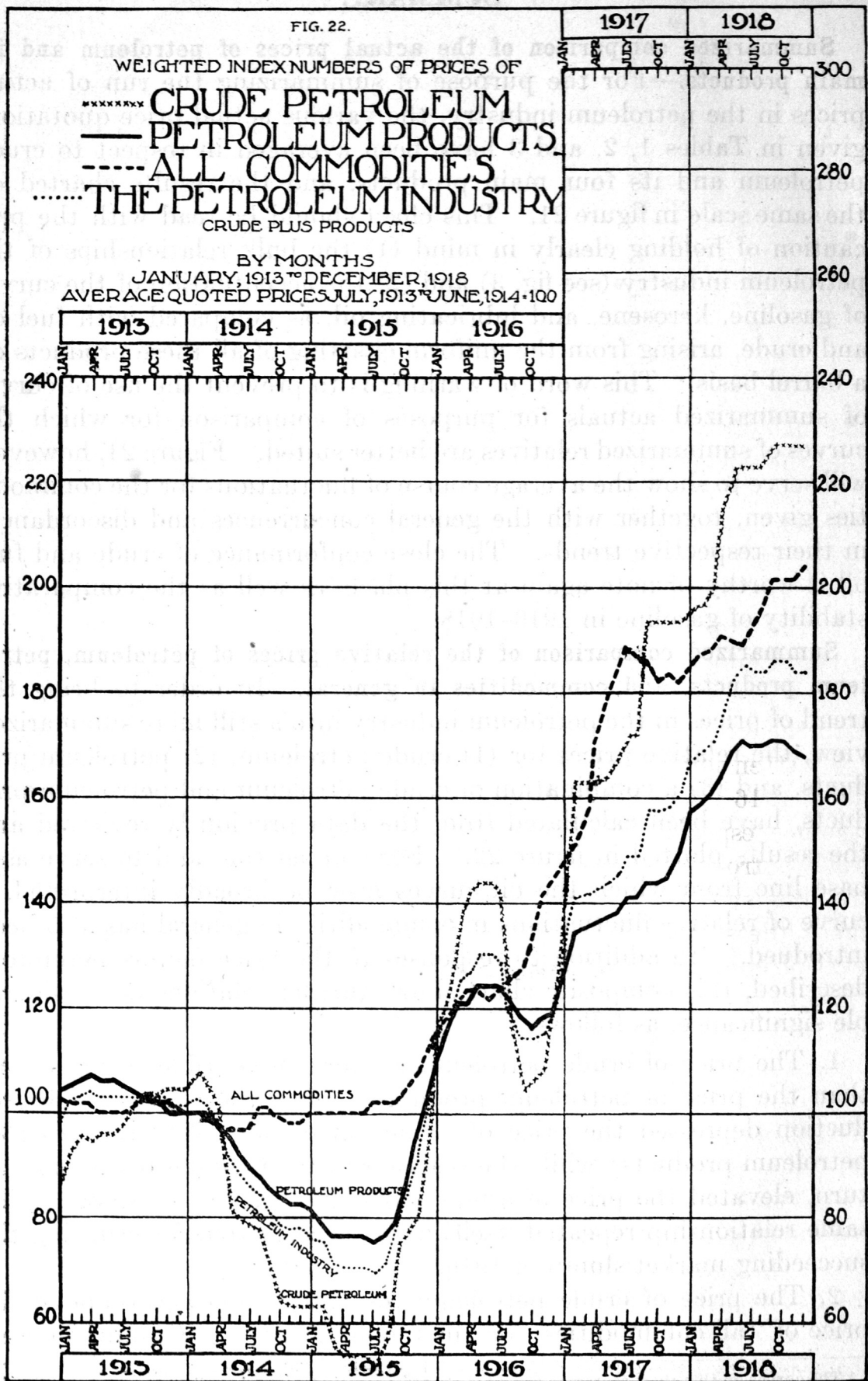


FIG. 22.—Relative prices (weighted averages or "index numbers"), of (1) crude petroleum, (2) petroleum products, (3) "All commodities," and (4) the petroleum industry (crude plus products).

sion, with a less accentuated repetition during the minor rebound of 1916. These changes form a striking example of the tendency of crude prices to advance with periodic fluctuations in sympathy with the status of crude production. The tendency, which is almost subject to mathematical expression, also illustrates the intensity of the reaction following depressions, which results in one or more minor depressions before the normal run of stability is reattained.

3. The rise in the price of crude petroleum over "all commodities" was sustained in 1917-18 in notable degree, in keeping with the generally accepted feeling that an increasing price was necessary to prevent a disastrous shortage of crude supply.

4. The result of the Government's plan of stabilization is graphically shown by the course of the curves in the latter half of 1918. Indeed the oil curves show greater response to stabilizing influences than does the curve of "all commodities" which, in large part, came under governmental influence a year earlier.¹ A comparison of the oil curves with the curve of "all commodities" from the middle of 1917 on, shows the tempered course of the commodity curve after it came under the influence of governmental price regulations, as contrasted with the course of oil still a free agent as to price until, at least, early 1918. Commodities in general were being retarded in price advance almost a year before the establishment of an Oil Division charged with the administration of petroleum and its products.

5. Attention should be called to the price of petroleum products since 1916 as compared with "all commodities." This relation assumes especial significance in contrast with the price course of crude petroleum during the same period, since petroleum products are thus seen to be lower in price than commodities in general by about the same degree that the price of crude is above the general level of commodities. The threefold relationship between "crude," "products," and "all commodities," especially when viewed throughout 1913-1918, displays a most remarkable interplay, with (1) "crude" sinking below "products" which in turn is beneath "all commodities" in 1915, (2) followed by a complete reversal of order in the first half of 1916, (3) succeeded by another reversal in the second half of 1916, (4) followed in 1917-18 by a divergence of "crude" and "products" with "all commodities" halfway between. With the curve of "all commodities" recognized as a base line representative of actual value, it is seen that petroleum products in 1918 are no more expensive (relatively) than they were during the period of depressed prices in 1915, and less expensive (relatively) than in 1913. On the contrary, crude is seen to be more expensive (relatively) than at any time previously in 1913-1918, with the exception of a few months in 1916

¹ The drop in the curve of petroleum products in the last quarter of 1918 is largely the result of the slump in fuel-oil prices.

THE PRICE & VALUE RELATIONSHIPS OF THE PETROLEUM INDUSTRY

1913 - 1918

U.S. FUEL ADMINISTRATION

AVERAGE MARKET PRICE PER BARREL

U.S. PRODUCTION

APPROXIMATE MARKET VALUE OF U.S. PRODUCTION

U.S. PRODUCTION X AVERAGE MARKET PRICE

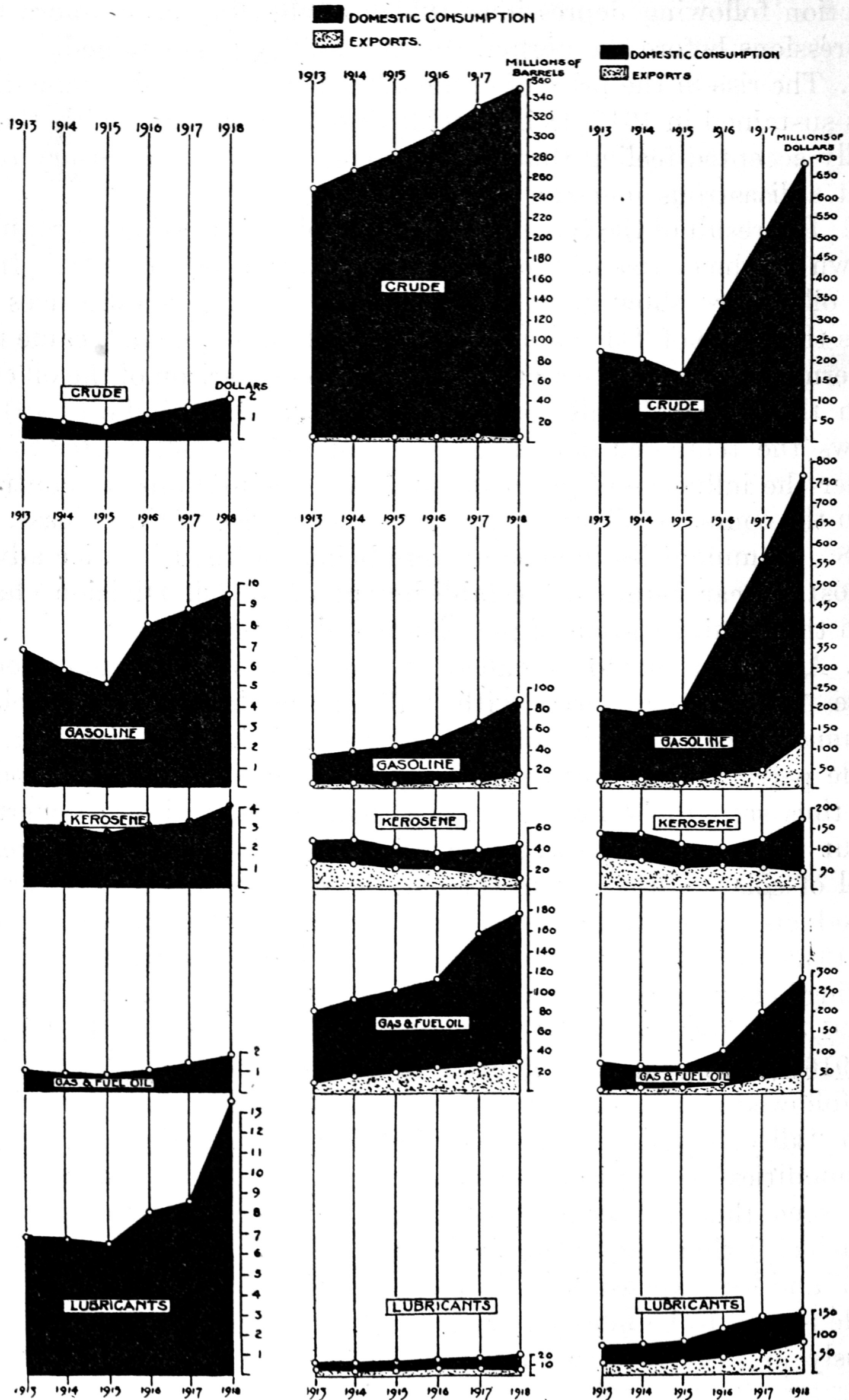


FIG. 23.—The price and value relationships of the petroleum industry, 1913-1918. Use for gaining a view of relative changes; not fully reliable for specific use, owing to imperfections of data.

when the crude market was recovering from the Cushing debauch. The significance of this outcome is that the peculiarities of oil give it a price reaction at variance with normal commodity groups, with the result that the law of supply and demand is not only displaying unusual tendencies in the field of oil, but evidence is accumulating to indicate that further anomalies are due to come into play as the situation develops in added degree.

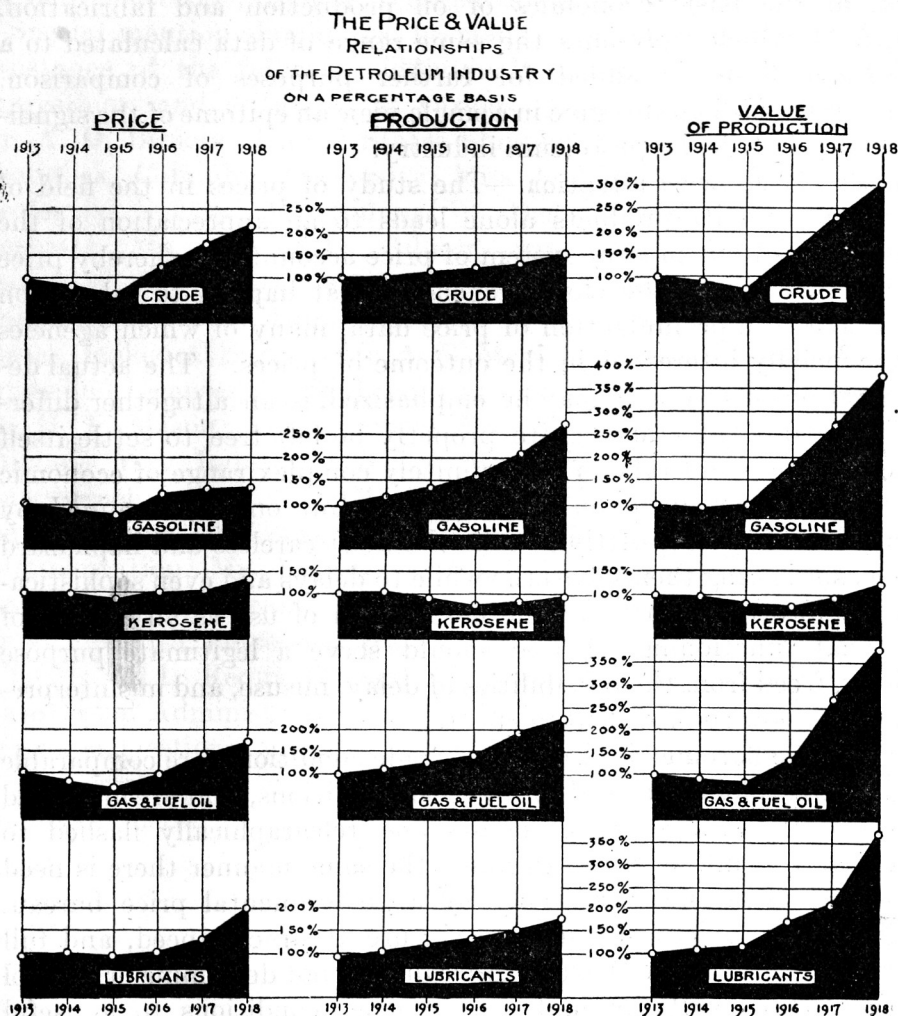


FIG. 24.—The price and value relationships of the petroleum industry, 1913–1918, reduced to a percentage basis. Data taken from Fig. 23 opposite. Use for gaining a view of relative changes; not fully reliable for specific use.

The price and value relationships of the petroleum industry.—As a final summary of the meaning of the price changes of 1913–1918 as regards the petroleum industry in its entirety, figures 23 and 24 are presented. Figure 23 shows in comparable form the average yearly prices for crude petroleum and its main products, the output of each of these products, and the respective market values obtained by multiplying the average yearly price by the production. This

diagram, representing a highly concentrated summary of the entire price situation, should be used with caution, in full recognition of the extent to which errors in the basic data are multiplied in the curves as charted. As showing relations, interplays, and tendencies, however, the diagram is distinctly serviceable and will bear close study in the light of the various discussions that have gone before. In a word, figure 23 shows the price situation in the mass and it reflects much of the basic economics of oil production and fabrication. Figure 24, which represents the same range of data calculated to a percentage basis, is added for further purposes of comparison. Together these diagrams give in a single view an epitome of the significance of prices in the petroleum industry.

Needs of the price situation.—The study of prices in the field of petroleum and its products alone leads to an appreciation of the inadequacy of our present system of price accounting, whereby price publicity is left to the chance agencies that happen to take upon themselves the promulgation of price data, many of which agencies are financially interested in the outcome of prices. The actual determination of prices, it may be emphasized, is an altogether different proposition and may quite properly be left free to settle itself under the give and take of the infinitely complex range of economic forces that bear down on this matter. But once determined by natural forces, prices oftentimes take the most careless and haphazard course, subjecting themselves the while to delays and even sophistications, before they arrive at the destination of use as an agency of industrial functioning. Prices should serve a legitimate purpose entirely, freed from the possibilities of delay, misuse, and misinterpretations, as now so prevalent in effect.

Prices, the barometric readings of trade conditions, are comparable to the meteorological records of weather conditions, that are measured at a country-wide series of points and telegraphically flashed to appropriate points of use. In much the same manner there is need for prices to be measured daily by a governmental price bureau using all the devices of science to insure accuracy, speed, and full publicity. And as the Weather Bureau does not determine or control weather, but merely promulgates weather conditions to a useful purpose; likewise a price bureau would not (nor indeed could, except through dishonesty), determine or control prices, but would merely raise the price agency to a higher point of industrial and social service.

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